This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.
+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.
+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.
+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

3 3433 07597168 3

TRANSACTIONS

OF THE

Seventh International Congress of Hygiene and Demography.

LONDON, AUGUST 10TH–17TH, 1891.

Patron:—HER MAJESTY THE QUEEN.

President:—H.R.H. THE PRINCE OF WALES, K.G.

VOLUME IV.

SECTION IV.
INFANCY, CHILDHOOD, AND SCHOOL LIFE.

EDITED BY C. E. SHELLY, M.A., M.D.,
Assisted by the HONORARY SECRETARIES of the SECTION.

LONDON:
PRINTED BY EYRE AND SPOTTISWOODE,
PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY.

1892.

-16860-

ASTOR LIBRARY
JUN
6
1893
NEW YORK

OFFICERS OF THE SECTION.

PRESIDENT.

J. R. Diggle, M.A., Chairman of the London School Board.

HONORARY PRESIDENTS.

Dr. Wm. Brown, New Zealand.
Prof. von Fodor, Budapest.
Prof. Henoch, Berlin.
Dr. Jacobi, New York.
Dr. Hyac. Kuborn, Belgium.
Monsieur Théophile Roussel, Senateur, Paris.

VICE-PRESIDENTS.

W. B. Cheadle, M.D., Senior Physician to the Hospital for Sick Children.
J. Langdon Down, M.D., J.P., Consulting Physician to the London Hospital.
Professor Gladstone, F.R.S., Vice-Chairman of the School Board for London.
Sir Philip Magnus, City and Guilds of London Technical Institute.

HONORARY VICE-PRESIDENTS.

Professor Gallandet, Washington, U.S.A.
Dr. Kotelmann, Hamburg.
Professor Rozsahegyo, Kólosvar.

COUNCIL.

The Rt. Hon. the Lord Egerton of Tatton, Chairman, Royal Commission on Education of the Deaf and Dumb.
The Rt. Hon. The Lord Aberdare, Chairman, Royal Commission on Reformatories and Industrial Schools.
Sir Richard Temple, Bart., M.P., Member of the School Board for London.
Sir Edwin Galsworthy, J.P., Chairman of the Metropolitan Asylums Board.
E. N. Buxton, J.P., late Chairman of the School Board for London.
J. E. Welldon, M.A., Head Master of Harrow.
Rev. J. W. Sharpe, H.M. Inspector of Schools (Metropolitan).
Colonel Prendergast, J.P., Chairman, Industrial Schools Committee, London School Board.
Colonel Onslow, late Inspector of Gymnasia.
Fletcher Beach, M.D., Medical Superintendent, Darenth Asylum, Dartford.
Clement Dukes, M.D., Physician to Rugby School.
George H. Savage, M.D., Lecturer on Mental Diseases at Guy's Hospital.
Frederick Treves, F.R.C.S., Surgeon to the London Hospital.

HONORARY SECRETARIES.

W. Pasteur, M.D., F.R.C.P.
T. A. Spalding, LL.B., London School Board.
F. Warner, M.D., F.R.C.P.
F. J. Wethered, M.D., M.R.C.P.

TABLE OF CONTENTS.

	Page.
Presidential Address	7
The Scientific Observation and Study of Children in Schools, and the Classes into which they may be grouped	10
Discussion	15
Physical Indications of Injurious Schooling	20
Discussion	26
Ringworm in Elementary Schools	27
Discussion	29
Epidemics in Schools	30
Handwriting in relation to Hygiene	47
Demonstrationen die Einführung der Steilschrift in die Schulen betreffend	53
Discussion	57
American Child-Labour Laws	57
An Objectionable Feature of some Burial Societies in their relation to Infant Life Insurance	67
Discussion	70
Defective Personal Hygiene as it affects the Teeth in Infancy, Childhood, and School Life	71
Resolution submitted by the School Board for Hull	87
The Working Curve of an Hour: an Experiment concerning Overpressure of Brain	87
L'Hygiène Scolaire en Belgique	95
Some of the Laws which Influence the Growth of the Child	103
Discussion	108
Physical Education	110
Physical Exercises in Elementary Schools: a part of the School Hygiene	114
Discussion	118
The Value of Hygienic Education to Women	119
Manual Training in Relation to Health	123
Discussion	130
Neglected Children in our Towns and Cities	131
Des progrès de la diffusion de l'instruction publique en Belgique, au point de vue de la criminalité et de l'aliénation mentale	137
The Development of the Reformatory and Industrial School System in England	146
L'enfant à tendences criminelles ou placé dans un milieu criminel	170
Discussion	174
Assistance des Orphelins considerée au point de vue de leur hygiène physique et morale	175
Ueber die Nothwendigkeit der Reconvalescenthäuser für Kinder	186

Page.
Free Dinners for School Children - - - - - - 191
Can Hungry and Half-clothed Children be efficiently Educated ? - - 195
L'enfant pauvre - - - - - - - - 196
Discussion - - - - - - 201
The Care and Treatment of Epileptic, Mentally Feeble, and Imbecile Children - - - - - - - - 203
The Care of the "Mentally Feeble" Child as distinguished from the "Imbecile" - - - - - - - 208
Antrag Erhebungen über psychopathisch minderwertige Kinder anzustellen 212
Kinder mit abnormer Kopfbildung - - - - - - 219
Discussion - - - - - - - - 221
The Education of the Blind - - - - - - 224
The Physical, Manual, and Technical Education of Deaf Mutes - - 237
Zur Hygiene der Sprache des Kindes - - - - - - - 241
Ueber die Sehschärfe der Schüler - - - - - - 247
On the Importance of Detecting and Treating Defects of Vision and of Hearing in Board School Children - - - - - - 252
Nécessité des études anthropologiques et anthropométriques dans la première enfance, la jeunesse, la vie d'école, et l'âge adulte - - - - 254
Discussion - - - - - - - - - 262

INDEX.

SECTION IV.

INFANCY, CHILDHOOD, AND SCHOOL LIFE.

Tuesday, 11th August 1891.

The Chair was successively occupied by
The PRESIDENT;
Dr. KOTELMANN;
Dr. CHEADLE.

Presidential Address

BY

JOSEPH R. DIGGLE, M.A., Chairman of the London School Board.

We have met, from all parts of the world, to take counsel together of the things which pertain to the well-being of the State. It is natural, therefore, that all that makes for the welfare of the children should come under our purview. Not that the children are less under the charge of their parents because they form a principal care of the State, but that the collective ripened experience of the community may be an assistance to the individual guardian of the child.

Care for all children as children, and not for the apparently strong and useful of their number, is the outcome of Christian civilisation. We do not look upon them merely as the means of perpetuating the human race. In the weakest and frailest amongst them we discern the latent capacity for a higher life; and precisely because in their case the physical organism hides rather than exhibits the true child, the duty is more clearly laid upon us of assisting the child to break through the barrier of hostile physical defects. In the performance of that duty the State has learnt to place a right value upon even imperfect human life, and the laws of Christian communities increasingly reflect in that regard the common sentiment of their peoples. It may be that one of the chief abiding results of this International Congress will be to quicken into active thought for these things any national conscience now lying dormant.

The broadest measure of the State estimation of child life is the care which the State bestows upon the education of children. Involved in the very idea of education is the perception of the innate capacity of the child for larger development. And this capacity varies with each child. Children are as alike and as diverse from each other as the leaves of the forest trees. Whilst we think of children, and care for them, collectively in large numbers, we must beware lest we lose in this collective dealing with them our grip of the individual characteristics of each child.

It is at this point that the danger of confounding education with teaching comes in. Our habit is to speak of the one thing as if it were the equivalent of the other. They are rather the complement of each other. Acting in unison, they are allied forces carrying into effect a common plan: acting apart from each other, they are like foes encamping upon a common ground. Let us therefore at the outset firmly grasp this principle, that teaching may often in no way mean education, and that the teacher may sometimes be educating in a manner directly opposed to his teaching. An educator, as apart from a teacher only, is one who has large sympathies with the children, and understands the higher possibilities of their nature. His function is to help the child to feel his way about the world, to understand something of the things he meets with, and to throw the light of a riper experience upon the path which opens before him. The ideal is a lofty one, but it is not incapable of general attainment; and the pressing need of the time is to raise teachers to the height of educators, and teaching to the level of education.

No successful work, therefore, can be performed with children, unless there be first of all a thorough appreciation of the value of the material with which we work. It is an obvious truth, but like many other things equally obvious, it is frequently overlooked. There are thousands amongst us who are keenly alive to the importance of training for dogs, or horses, or cattle, who would practically allow the children to grow up anyhow. And the parents are not few who would throw upon the State the responsibility which nature has imposed upon them of caring for their own offspring.

Perhaps the most difficult of all social problems arises here. The value of child life to the State is not less because surrounding the child there may be the vicious influences of parental neglect. Take, for example, the much debated subject of providing for destitute children, and for the children perhaps more destitute still in fact, though not in the eyes of the law, without at the same time loosening the tie of parental responsibility, and weakening the force of its obligation. The immediate solution of the problem surely depends upon the point of view from which it is regarded. Some think that the immediate thing to be done is to safeguard what appear to be the general interests of the State. Others think that the immediate thing to be done is at once to succour the child. One path travels down from the State to the child, the other travels up from the child to the State. Believing as I do in the untold value of child life to every State, I infinitely prefer

the second mode of dealing with the problem. Without in the least hindering every effort to reform bad parents, the most hopeful course in the interests of the State appears to me to be the training up of children to be strong and good. What I would once more enter a protest against is the plan of leaving the child to act as a sort of buffer between the engine of the State and the stolid inert mass of parental neglect.

For, in truth, the necessity for State interference at all in the upbringing of children arises from some form or other of parental neglect, coupled with the advantages which the complete organisation of the State offers as a means of co-operating with good parents in the performance of a natural duty. In theory, the whole duty lies with the parent; but the advantages of co-operation become apparent in the employment of a teacher, in the use of a school as a common home, and still more in the general supervision which the State exercises in order to ensure that both teacher and school are adequate for their purpose. In all cases, to some extent, the State interferes. The moot point is in what aspect the interference shall be regarded. Are we to look upon it as the natural and permanent attitude of the State, or as a temporary and makeshift provision for a pressing need until a better ideal can be attained? Which point of view affords the best outlook for the future? That the State should think for all, and act for all, or that State powers should be strictly limited to their narrowest extent, and the fullest possible play should be given to individual responsibility and action? Shall we look upon children as being primarily the children of the State, or of each separate home? Working as I do along the path which leads from the child to the State, between the child and the school I find the home. Is the action of the State to touch the internal economy of the home? Would it be well for the home that the action of State interference should be perceptible there? And if not well for the home, is it well for the child?

Whatever may be the outcome of the future, it is clear that some sort of State interference is a necessity for the present. The exigencies of our modern civilisation, not less in our crowded cities than in our thinly-peopled villages, invite the intervention of the State in the interests of the general community. The influence of law surrounds and presses upon us like a social atmosphere. Our main business is to take due precautions that the intervention of the State, where it occurs, shall proceed upon right lines, and in directions where experience indicates that success will attend upon it.

Thus the healthiness of the schoolroom, the suitability of its arrangements and of its surroundings for the purposes of a school, its appointments for the purposes of teaching, are all matters of vital importance to the whole of the community who make use of it. In what manner these things can best be secured the papers and discussions of this Congress may help to point out with clearness and fulness.

Again, the entire range of the teaching which is intended for the development of the whole child concerns the community still more than the general suitability of schoolrooms as places where teaching is given.

Not a part only, but the whole of a child's nature demands separate care. Unless the community makes this, too, a matter of the deepest concern, it is destroying a part of its natural wealth. At times there has been a tendency to make the range of teaching coincide too much with the knowledge of books and too little with the experience of natural things. The culture of physical powers has been neglected, with a consequent loss of physical strength and of graceful bearing. Too much learning from books apart from the things themselves has led to a weakening of the faculty of observation, and to a loss of the aptitude for independent reasoning from observation and experience combined. Too little care for the spiritual capacity of the child has blunted the moral perception and retarded perfect intellectual development. Stunted or perverted ideas upon these cardinal principles, when they take the form of State laws, can only be administered at the loss of the community. From our deliberations here, where the widest freedom of utterance prevails, it is no small consolation to think that many will strike the one note which may harmonise many discords when insisting that the importance of developing the entire physical, intellectual, and spiritual capacities of children far transcends the minor matters which create divisions amongst us.

In this spirit we welcome those who, from other lands than our own, are assisting in the work of this section. We have a common aim, and we work in a common cause. As of old we look for "a city of truth," in which "there shall yet dwell old men and women, every man with his staff in his hand for very age." "And the streets of the city shall be full of boys and girls playing in the streets thereof." Among our "national manufactures" we think with Ruskin, that "that of souls of a good quality" will "at last turn out a quite leadingly lucrative one." Some words of his I leave with you to inspire the work of this section: "In some far away and yet undreamt of hour," he says, "I can even imagine that England may cast all thoughts of possessive wealth back to the barbaric nations among whom they first arose; and that while the sands of the Indus and adamant of Golconda may yet stiffen the housings of the charger, and flash from the turban of the slave, she, as a Christian mother, may at last attain to the virtues and treasures of a heathen one, and be able to lead forth her sons, saying, "These are my jewels."

The Scientific Observation and Study of Children in Schools, and the Classes into which they may be grouped.

BY

FRANCIS WARNER, M.D., F.R.C.P.

Modes of observing and studying their condition.—Assuming that it is desirable to know the condition of the children in a school, I am of

opinion that two independent reports should be made on schedule forms of all children considered by the reporters as presenting points worthy of notice (1) by the teachers, visitors, inspectors, &c., (2) a scientific report based upon viewing each child while standing still and also while performing some simple action. My province deals with the later method of report.

Children can best be seen in a large and well-lighted room; some of the London board schools have halls admirably adapted for the purpose. The children being drawn up in ranks, a standard at a time, or in groups of about 40, the observer can view each individual. It is convenient to fix the child's eyes while he is under observation by asking each in turn to look at an object held up (I use a shilling at the end of a pencil). The trained observer can read off the physiognomy of the individual features and their parts, the facial action and expression, the eye movements, the balance of the head and body, &c., as quickly as a printed line. The children are then requested to hold out their hands straight, the action being shown them momentarily, the action and balance are noted as a further indication of the condition of the nerve-system. Finally, the palate is inspected in each case. At each stage children presenting deviations from the normal are asked to wait with the teacher. Any cases not picked out may now be presented by the teacher; the selected cases are kept, the rest are dismissed to the class-room. Each of the selected cases is then reviewed individually, and the schedule form is filled in, conditions printed on the schedule are ticked if normal, and deviations therefrom are verbally described. The teachers' report of mental status is entered or filled in by them afterwards. In this method a fairly uniform standard of observation can be maintained. A tape measure for the head circumference is useful; occasionally some detailed inquiries may be made, or some brief mental examination conducted with the teacher may be desirable, but as a rule no questions were asked of the child. Time prevents me from giving details of my methods of observation, and the signs observed, but these have been published. This method works smoothly and uniformly, with a minimum of trouble to teachers and pupils. The teachers generally acknowledged that the dull children in the school had been picked out by observation.

The following remarks are based upon the observation of 50,027 children in schools which I undertook for a joint committee of the British Medical Association* and the Charity Organisation Society. Analysis and study of these observations suggest various classes or groups of children, we are concerned with their scientific definition, their relative numbers and distribution. A general analysis of the cases recorded is given in Table I. I hope later on to make detailed analysis and to trace the conditions of defect through the standards of school life. The local distribution of defects in development is dealt with in a paper presented in the Section of Demography.

---

* Towards the expenses of this inquiry grants have been made by the British Medical Association on the recommendation of their Scientific Grants Committee.

I. Table giving a general analysis of the cases seen.

No. of Schools seen.		No. of Children seen.	No. of Children noted.	Cases with Defect in Physical Development.	Cases presenting abnormal Nerve Signs.	Delicate, Pale, or Thin (Nutrition low).	Reported by Teachers as mentally dull.	Eye Cases: Squints, &c.; not ophthalmia.
Boarded Institutions. I.—XXXIV.	Boys -	8,246	1,904	1,324	1,333	291	801	287
	Girls -	5,403	962	671	557	156	441	159
Total - - -		13,649	2,956	1,995	1,890	447	1,242	446
Public Elementary Schools, &c. XXXV.—CVI.	Boys -	18,638	3,575	2,292	2,080	739	1,415	549
	Girls -	17,740	2,645	1,564	1,517	817	1,022	478
Total - - -		36,378	6,220	3,856	3,597	1,556	2,437	1,027
Totals I.—CVI.	**Boys -**	**26,884**	**5,569**	**3,616**	**3,413**	**1,030**	**2,216**	**836**
	Girls -	**23,143**	**3,607**	**2,235**	**2,074**	**973**	**1,463**	**637**
Total - - -		**50,027**	**9,176**	**5,851**	**5,487**	**2,003**	**3,679**	**1,473**

The classes or groups of children found in schools:—

(1.) *Children well made, with a nerve-system acting well, and average or bright at school work.* Of these there were among the 50,027 seen—Boys, 21,315; girls, 19,536; total, 40,851.

Such pupils are the average or normal, hence they do not appear further in our tables. It is seen here, as in most other cases, that the girls are better than the boys. In this work search was made for the abnormal and pathological, it would be interesting to re-examine these normal children to determine points of relative excellence, searching for those best developed in body and mental faculty; this could be done. Scholarships would be most advantageously given to the best made children.

(2.) *A group similar to the last, but slow at lessons* (reported dull by teachers), *i.e.*, children presenting no defects of development and no abnormal nerve-signs—seen Boys, 185; girls, 130; total, 315. It is important to differentiate such pupils from those with defective brain conditions, some children's bodies and brains are well developed and sound though presenting no present faculty for school lessons, as the teacher's evidence shows. The mental examination and history may, on the other hand, show grave defects in intellectual and moral faculty. Many of this group were "eye cases," some "cripples," several were presented by the

teachers, not having been noted by us. An analysis will be given in the full report.

(3.) *Cases presenting defects of development of the body of various kinds.* *See* Table I.

It is not intended to represent children as exceptional from an educational point of view, because some defect was present. Analysis of the various defects shows them to be of different importance. This subject has been dealt with in another paper,* demonstrating their relative co-relation with "mental dulness," "abnormal nerve signs," and "low nutrition" respectively.

(4.) *Cases presenting abnormal nerve signs.* *See* Table I.

Their significance varies in two directions, the one group is associated with low development, the other with delicacy and nervousness; they vary in different schools, and depend much upon methods of training. Information concerning classes 3, 4, has been presented to division of Demography.

Certain groups of children are best defined by the association of two or more physical conditions.

(5.) *Cases presenting defect in development and abnormal nerve signs*—Boys, 1,975; girls, 1,096; total, 3071. Such children are usually dull at work, and are often of low nutrition.

(3.) *Cases presenting defect in development and abnormal nerve signs also indications of low nutrition.* Boys, 412; girls, 381; total, 793.

(7.) *Eye cases.*—Obvious defects or disease were recorded, but no tests were applied to detect errors of vision or refraction. Ophthalmia was seen in certain day schools, but these cases were not recorded. *See* Table I.

(8.) *Deaf or partially deaf.* — Boys, 34; girls, 33; total, 67. Tests for hearing were not generally used, but when a child was found deaf it was noted.

(9.) *Cases crippled, deformed, or maimed.*—Boys, 157; girls, 84; total, 341. These children varied greatly, many are partially incapacitated for life, others only temporarily, some are mentally dull, others bright; they also differ greatly in physical health and strength.

(10.) *Epileptic.*—Boys, 32; girls, 23; total, 54. These cases were asked for in every school. Any case with a history of epilepsy or fits was recorded for what it was worth. It would appear that most epilectic children are frequently absent from school.

(11.) *Cases selected as feeble or exceptional in mental status.*—Boys, 124; girls, 110; total, 234. This group includes cases where the results of observation coincided with the teacher's opinion as to mental defect; it includes many imbeciles, obvious brain defects and disease, while less serious cases are

* Meeting of British Medical Association, July 1891.

also given. It is difficult to define what physical conditions alone indicate the child as unfit for average training, and I think an arbitrary attempt to do so must fail. Speaking generally, I would suggest that classes 5 and 6 need special attention in school, and should be known to the managers.

(12.) *Children delicate, pale, or thin (low nutrition).*—This condition shows a high degree of co-relation with defects in development and nerve-signs, also with mental dulness. No inquiries were made in day schools as to the feeding of the children.

The 2,003 children with low nutrition presented the following co-existing conditions.

TABLE II.

—		Total Number of Cases of Low Nutrition.	Defects in Development.	Abnormal Nerve-signs.	Defects in Development and abnormal Nerve-signs.	Dull in School.
Boarded Institutions. I.—XXXIV.	Boys	291	199	194	119	97
	Girls	156	133	108	76	85
Total		447	332	302	195	182
Public Elementary Schools, &c. XXXV—CVI.	Boys	739	534	441	293	305
	Girls	817	593	490	305	310
Total		1,556	1,127	937	598	615
Totals	Boys	1,030	733	635	412	402
	Girls	973	726	598	381	395
Total		2,003	1,459	1,233	793	797

The study of children in school.—The general outcome of this work indicates the advisability of studying the pupils in two ways, (1) by mental tests, and (2) by physical examination or inspection. For the gain of direct scientific knowledge it is desirable to note all departures from the normal types. It appears to be a great gain to note, not only points in development and physiognomy, but also the nerve-signs indicated; those postures or balances and movements or actions which were noted as signs, were selected after much labour in observation, analysis, and comparison, and they seem well suited for the purpose in hand. They are readily recognised, and can easily be taught by means of casts, diagrams, and demonstration.

Physical examination by inspe[illegible] useful (1) as a means of selecting cases for special mental re[illegible] (2) as supporting or refuting

a report founded on mental tests only. The double mode of inquiry is specially necessary to detect certain cases; the mental test alone would leave out of view those nervous children who suffer much, but are usually bright at work and interested in it, and tend to pass the standards quickly; on the other hand, grave mental defects may occur with brains good for all other functions.

As a hospital physician, one sees many children, delicate, feeble-brained, children with small heads, nervous children with headaches, chorea, occasional fits, those partially deaf and blind, conditions without a tendency to a fatal termination, and not preventing a modified and adapted education—such children need provision for their training; without it they will probably tend to failure and incapacity in after life. They should be known and specially cared for.

DISCUSSION.

Dr. Shuttleworth (Lancaster) said he found himself unexpectedly called on to move a resolution which he wished had fallen into abler hands. He supposed that the honour had fallen to him because he had from the first been to some extent associated with Dr. Warner's work just reported, and in 1888 had moved the appointment of a Committee of the British Medical Association for a scientific examination into the condition of school children. This committee (which consisted only of medical men) had last year been reinforced by the Charity Organization Society taking up the subject, and appointing as members of its committee some distinguished educationalists and others who took a philanthropic interest in the subject. The result had been that additional energy had been infused into the inquiry, and now the result of an examination of 50,000 children was before the meeting. He might take the opportunity of saying that though a committee was responsible for the reports presented to the societies, to Dr. Warner properly belonged the credit of the work achieved. He would, without further preface, propose the *Resolution*, which was as follows :—

> "That according to returns prepared by Dr. Warner on the feeble-minded, epileptic, &c., it would appear that an appreciable number of children, though not imbecile, are more or less defectively developed in brain and body. That for their training and education special arrangements are necessary, and that in the absence of such arrangements there is great probability of grave mental and moral deterioration."

Taking these words as his text, he would make a few remarks upon some of the topics suggested. Speaking in a general way, it might be said that the peculiarities of brain development and condition noticed by Dr. Warner divided themselves into (1) cases in which nerve and brain power was defective, and (2) cases in which the action was irregular; in other words, the *dull* children and the *nervous, irritable* children. For these two classes different treatment was required, and it was to be hoped that in any arrangements made for the instruction of exceptional children their individual characters would be studied. And (he thought) a system of skilled medical inspection in schools should be instituted. As regards

number (so far as the inquiry had gone) no less than 1·5 per cent. of the children in elementary schools required specially-adapted instruction; and he rejoiced to hear that the actual experiment of special classes for exceptional children was shortly to be tried under the auspices of the London School Board. Such classes had already existed under the name of "auxiliary classes" in the public school systems of Germany and Norway, with encouraging results. In default of such special arrangements, exceptional children were either neglected or pushed beyond their powers, to the detriment of themselves and of their normal school companions. The neglected child grew up a permanent burden to the community, while the "wrong-brained" child, injudiciously treated, was apt to swell the criminal ranks. In conclusion, he ventured to say that the figures presented by Dr. Warner justified an appeal to the Government for an official inquiry, embracing the whole of the kingdom, as to the number and educational necessities of these exceptional children. Much good had been done by private effort, thanks to the industry of Dr. Warner and the support of the societies under the auspices of which his inquiries had been made; but the subject was one of imperial importance and demanded Government aid.

Mr. Graham Balfour seconded this motion, as representing the Charity Organization Society, pointing out the great advantages gained by the analysis of feeble-minded children suggested by Dr. Warner, by which any scientific education of such children was for the first time rendered possible. This paper seemed to mark a distinct advance in education in this country, but it was most important that the investigation should continue to be carried on.

Dr. Fletcher Beach (Dartford) rose to support the resolution. He had been called upon to do so, partly because he had been connected with Dr. Warner in the early part of the inquiry, and partly on account of his position as medical superintendent of the Darenth Asylum for Imbecile Children. Dr. Warner had furnished him with particulars of 85 out of 234 exceptional children whom he had observed in his inquiry. On going through them he observed a class with small heads, slow in answering questions and violent in temper, and another class with defective palates, defective in make and semi-imbecile. There was also a class of evil-minded, lying, sullen children, kleptomaniacs, and needing moral instruction. For these classes a school should be set aside. These should not be taught with the feeble-minded children, for whom he was glad to hear the London School Board was going to provide instruction. Then Dr. Warner had furnished him with a table showing the number who would require special care among 36,378 in public elementary schools. He found that there were 266 with defective development, abnormal nerve signs, low nutrition, and mental dulness, 48 epileptics, and 128 feeble-minded. Special instruction would no doubt improve these, for Dr. Shuttleworth informed him that in the schools for abnormal children which had been established in Norway one-fourth were passed on to ordinary schools, one-fourth passed confirmation, which was necessary before employment could be obtained, one-fourth were sent to schools for imbeciles, and one-fourth were sent home as incapable of improvement. Such a result was to be hoped for in England through the agency of school boards. There is no doubt that if the education of feeble-minded children be neglected they would, at a later age, lead criminal and immoral lives; this has already been found

by the National Vigilance Society. The education of epileptics should also be undertaken; it is a blot on civilization that they are at present neglected.

General Moberly observed that Dr. Warner's method of examining children in schools was very gentle and accurate, and was supported by teachers who were greatly interested in the investigation. He alluded to the proposals of the School Board for London to establish three schools experimentally. Very little was known of the system in England; but great encouragement was afforded by Dr. Shuttleworth's report as to success in other countries.

The physical development and the cleanliness of children must be cared for, in the hope of enabling them to return to the ordinary school, if not in the standards which, according to age, they should join, at least in *some* standard, though possibly they may learn little but such manual work as may facilitate their maintenance.

The medical officer of the board would have to examine each child before he or she is admitted into the special school, and will no doubt from time to time inquire into their condition to see what benefit has been obtained.

Dr. A. Jacobi (New York) said, there is one reason why these resolutions ought to be passed, which has not been dwelt upon enough by the last speaker. You want to advance the weak; so do I. But it is of greater importance to protect the strong and the intellectual. Whenever all classes of intellectual and unintellectual pupils are found together in the same school, both the method of teaching and the result of learning are but a low average. By having the weak and strong together you do not benefit the former, but you harm the latter by preventing them from reaching their possibilities.

Director Regierungsrath Dr. Moritz Gauster (Wien) sagte:—Ich fühle mich verpflichtet, für die geistesschwachen Kinder einzutreten und den Congress zu bitten, mit der Autorität der Wissenschaft und seines geistigen Ansehens für die Pflicht und Nothwendigkeit der öffentlichen Fürsorge für solche Kinder einzutreten.

Diese Fürsorge ist nicht nur ein Gebot der Menschlichkeit, sie ist auch im pekuniären Interesse der Gemeinwesen. Man wird zwar die Hoffnung der Vergangenheit aufgeben müssen, solche Kinder in nennenswerther Zahl zu heilen, aber bei einer Reihe gelingt es, sie zur Erwerbsfähigkeit unter Leitung oder selbst auch in beschränkt selbstständiger Art zu entwickeln.

Ich habe desswegen schon gestern dem verehrten Präsidium der Sektion einige Thesen in diesem Gegenstande angekündigt; da aber eine allgemeine alle defekten Kinder umfassende Resolution eben vorgelegt wurde, unterstütze ich wärmstens diese, will jedoch den Standpunkt, von dem die öffentliche Fürsorge für diese Unglücklichen ausgehen muss, in nachfolgenden Sätzen (Thesen) darlegen.

Ich bemerke, dass England für Unterbringung geistesschwacher Kinder sehr viel geleistet hat; ob für die in Folgendem bezeichnete Gruppe jener Kinder, die im Hause erzogen werden können, aber eigenen Schulunterrichtes bedürfen, ausgiebig vorgesorgt ist, weiss ich nicht. In Deutschland ist die Fürsorge durch Privatwohlthätigkeit und die der Gemeinwesen (Staat und Städte) zur Geltung gebracht; und in Oesterreich haben wir einige wenige Sonderschulen für Geistesschwache und für schwerere Kranke durch Privatwohlthätigkeit auch ein paar Anstalten.

Doch muss diese Fürsorge umfassend zur Geltung kommen, und zwar von nachstehenden Grundsätzen aus:—

I. *Selbe theilen sich in drei Kategorieen:—*

a. Solche Kinder, welche geistesschwach sind, bei gewöhnlichem Schulunterrichte nicht oder nicht entsprechend weiter geistig entwickelt werden können, die andern Kinder im Unterrichte aufhalten, aber bei häuslicher Pflege weiter sich, wenn auch langsam, entwickeln können, wird ihnen entsprechender Unterricht zu Theil und die häusliche Pflege durch sachverständigem Rath geregelt wird.

Für solche Kinder sind eigene Schulen oder Schul-Abtheilungen zu errichten und sind diese und die Eltern durch die Schul- oder Amtsärzte über entsprechende Pflege und Behandlung zu belehren. Dies ist vorderhand nur in grösseren Gemeinden möglich; das Unterrichtsziel muss für jeden Jahrgang herabgesetzt werden; die Lehrer müssen im Unterrichte geistesschwacher Kinder praktisch geschult sein.

b. Solche Kinder, welche erheblich geistesgeschwächt sind, in häuslicher Pflege weder entsprechende Pflege noch Erziehung finden können, aber noch mehr minder geistig entwickelungsfähig sind.

Für solche Kinder sind eigene Anstalten nothwendig, in denen Erziehung und Pflege von sachverständiger Einsicht geleitet, und der Unterricht in Elementargegenständen, dann in Handfertigkeit und Gewerbe von fachlich vorgebildeten Lehrern durchgeführt wird. Solche Anstalten stehen am besten unter pädagogischen Leitern, wenn der ärztliche Einfluss bei Beurtheilung und Behandlung des Kindes je nach seinem individuellen Leiden gesichert ist.

c. Solche Kinder, welche geistesschwach in so hohem Grade sind, dass eine nennenswerthe Entwickelung in geistiger und nicht selten auch in körperlicher Hinsicht nicht möglich erscheint.

Für solche Kinder sind Asyle zur Pflege und zum äusserst vorsichtigen Versuche geistiger Hebung und Schulung nothwendig, in welchen Asylen sie meist entweder lebenslänglich gepflegt werden müssen, oder die später, wenn sie ganz erwachsen sind, der Familienpflege oder der öffentlichen Versorgung zu übergeben sind.

II. *Alle Schulen und Anstalten bedürfen eines sachverständigen ärztlichen Beirathes: die Asyle für entwickelungsfähige geistesschwache Kinder sind Kranken- und Erziehungsanstalten; jene für nicht oder nur wenig entwickelungsfähige sind Siechenanstalten. Auf beide hat die Gesundheitsverwaltung entsprechenden Einfluss zu nehmen.*

III. *Es ist Pflicht der öffentlichen Gemeinwesen, für Pflege und Erziehung solcher Kinder zu sorgen, theils unmittelbar durch Errichtung von Schulen und Anstalten, und Unterbringung der Armen in selben, theils mittelbar durch Ueberwachung der Fürsorge für solche Kinder.*

Dr. J. Langdon Down remarked that the value of Dr. Warner's inquiry depended entirely on the truthfulness on which his arguments are based. The basis is that there is a co-relation between physical conformation and mental power. It would be interesting to Dr. Warner to know that he had entered into a similar inquiry 30 years ago with regard to the physical conformation of idiots and imbeciles, and that he then wrote "The condition of the idiot is not simply one of mental alienation. It " frequently presents, also, grave physical deterioration; and this physical " alteration is as much a test of idiocy as is the low condition of mental " power." Subsequently, he had been accustomed to investigate the physical and mental condition of children who had but slightly enfeebled mental power, with results confirmatory of the results of Dr. Warner's

inquiries. It was very satisfactory to him to find so completely confirmed observations and sttements which he had made so many years ago. He dwelt on the close relation between feeble-mindedness and criminality. Many years ago he investigated carefully the physical and mental condition of the inhabitants of one of Her Majesty's prisons, and was much struck by the fact that a large number of so-called criminals were really feeble-minded people. While thanking Dr. Warner for his statistics, he was of opinion that the inquiry should be much more extensive and carried out over more varied fields.

Dr. Jno. Milson Rhodes said:—I have great pleasure in supporting the resolution that has been proposed by Dr. Shuttleworth. I believe that the inquiry should be extended to all England to ascertain the real number of feeble-minded children. Four years ago I had occasion to estimate the number of feeble-minded children in the north of England. I was therefore anxious to ascertain how far the last census returns could be depended upon, and for that purpose made personal inquiries among the people in my locality; the result was that I found that not above one in five is returned in the schedules, even if idiotic.

This is a question that will have to be faced, and it is not to the credit of England that we have allowed France to advance faster than ourselves. At the present time there is a Bill before the French Chambers to compel every department to provide two establishments, one for epileptic and one for non-epileptic idiots.

Three years ago the North-Western Poor Law Conference urged the claims of the feeble-minded on the State, and as one of the representatives of that Conference, I am quite sure that there will be no opposition to proper provision being made on the ground of expense by the poor-law guardians.

Mr. J. Peeke Richards (Hanwell Asylum) said that a more thorough examination of children ought to be made, and that it should be compulsory for every child on entering a school, whether board school, middle, or upper class school, to be examined by a medical officer, and for the result of that examination to be recorded. It would now be almost impossible to thoroughly examine all children now in schools, but legislation should in future make it compulsory for every child on entering a school to be examined physically, as is done now with recruits entering the army and navy. Slightly imbecile children of the lower classes, if properly taken in hand during school life, would tend to lessen considerably the number of admissions into the county lunatic asylums; this would not only be of considerable advantage to the welfare of the State in general, but to the ratepayers in particular.

Mr. Noble Smith thought that some practical deductions ought to be drawn from the valuable statistics placed before the meeting by Dr. Warner. The popular idea among the public was that it did not so much matter that the children should be deficient in at least physical development or deformity, because they would most probably if not certainly "grow out" of their deficiencies. This idea is not in accordance with medical experience. To elucidate this point Mr. Noble Smith had observed large numbers of artisans, and he had found out of batches of these adults going to or coming from work, that nearly as many possessed some crookedness of limb—especially of legs, as there were straight men. What was the result? Most of these men were unfitted to enter the army, and all of them were heavily handicapped for the

battle of life. He had no experience as to their degenerating into criminal classes, but they certainly often became discontented members of society. Among the classes who attend the more noisy mass meetings in Hyde Park a very large number of crooked legs may be observed. As a remedy for these defects, Mr. Noble Smith urged that our attention should be directed to improving the nutrition of children and to modifying their work, physical as well as mental. He thought that if the nutrition were better, we should hear less of mental over-pressure. We ought to approach the homes of the children and teach the mothers how to bring them up well and strongly.

The Resolution was then put by the **President** and carried unanimously.

Physical Indications of Injurious Schooling.

BY

OCTAVIUS STURGES, M.D., Physician to, and Lecturer on Medicine at, the Westminster Hospital; Physician to the Hospital for Sick Children.

The object of this paper is to call attention to movement disorder in school children, to describe the early signs of such disorder, and to offer some suggestions to aid teachers and parents to discover it. The subject properly belongs to the hygiene of school life, and if it cannot be presented simply and without technicality to those whom it chiefly concerns, it is best let alone. It must be understood, therefore, that my remarks are addressed to teachers and not to doctors, and that upon controverted questions of pathology and treatment I shall say nothing.

Now, the physical indications of injurious schooling are of many degrees, not all of them obvious to unskilled observers. The early restlessness of the little child under school difficulty is very apt, as I shall show, to be overlooked or misunderstood. As a consequence, it presently grows into the disorder known as St. Vitus' Dance. But it is not of the fully developed disease that I would now speak, except to show how it comes and how it may be avoided. "Prevention is better than cure." The mental strain and consequent physical infirmity of school-pressure it is easy to recognise, and easy to relieve.

Take a very common case as the pattern to start from. A thin, pale girl of 11 is brought to hospital in consequence of continual restless movements of face and limbs. These are now of such severity that the child has to be fed. This is her history: The father is out of work and in hospital; the mother has charge of chambers, but, being rheumatic, cleaning out the place falls chiefly to the child; so does also running errands in the evening, the season being midwinter. These domestic cares require early rising and early work, while the night errands interfere with study and preparation for morning school.

The child is sometimes late therefore, and her lessons are ill learnt. For these faults she is often "kept in" and "slapped." Presently the mother notices that the girl is restless at night, calling out in her sleep, and rambling about school work. So matters go on from day to day; the house drudgery, the school punishment, and longer hours, and, finally, after an interval of errand-running, and the scanty meal of a child whose father is out of work, to bed and disturbing dreams until recalled (at 6 a.m. in winter) to the labours of another day. At length the limb movement and grimacing excite attention, and the mother in much alarm brings the child to a doctor.

Such and such-like is the common tale. During six months I find that 40 cases of St. Vitus' Dance have been admitted into the Hospital for Sick Children (November 1890—May 1891). Nine may be selected as the best examples of that affection when school-bred.* Their ages are between 8 and 12. *All but one are girls.* The exciting cause (in most instances long in operation) may be shortly defined as "school worry"; for instance, "bothered with lessons," "puzzling over sums" (a fruitful source of evil), "preparing for examination." In three cases the excitement and overwork attending examination is a conspicuous cause. Five of the nine children *were still kept at school after their restlessness had been noticed, and only removed when St. Vitus' Dance had developed so fully as to render them absolutely incapable of school work and sometimes even of speech.*

One example I will briefly quote to show the extreme sensitiveness of these children on the first access of movement disorder, a condition of nervous instability which demands notice no less than that of the limbs. This child had been working very hard for examination, and especially harassed by sums. She was in great apprehension about passing in arithmetic, and the overstrain had been so nicely timed that it culminated in obvious mismovement—actual dance of St. Vitus—just when the child was in for the first day's examination. Thus it happened that, in the course of writing, her restless left elbow by misadventure jogged the right arm of a boy sitting next her, thereby, to her great grief, spoiling his paper, and at the same time producing such mental emotion as greatly aggravated her own disorder.

I repeat that the St. Vitus' Dance (or Chorea) of the doctor is but the final stage or full development of a disorder which potentially has long existed unnoticed. From its beginning to its end this disorder is self-aggravated; it grows out of material of its own providing. A child discovers, to her own surprise, that her limbs and body have passed out of her control. Neither hands, nor feet, nor tongue are wholly obedient. And being a school child, and it being the way of the disorder to afflict the hands first and most, school work is made extra difficult. With all her pains, writing and summing are ill done; she reads indistinctly, writes badly, and is wanting in "deportment." And when punishment

* An abstract of these cases will be found in the Appendix. In 1889, 55 choreic patients were admitted, 42 girls, 13 boys. In 1890, 51 patients were admitted, 34 girls, 17 boys. The out-patients were much more numerous.

follows, instead of sympathy, the child assents to it, in the knowledge, which her own small experience furnishes, that some penalty is the invariable consequence of faults of this kind, but not without a vague sense of the world's injustice. Yet the affliction and the dread of punishment will not (as she foresees) make the day's work better done, but worse.

There is a continual falling off in lessons and a continual recurrence of penalty, until, sooner or later (and sometimes it is very late), it occurs to someone, wiser than the rest, that the child is not perverse, but ill.

I do not forget that school lessons are ill done, not only from the hindrance of St. Vitus' Dance, but also, and still more, perhaps, from perversity, ill-temper, and distractions of many kinds. I would not have you continually suspecting St. Vitus' Dance. My object is to make you separate it, or rather its premonitions, as you most easily can, from other things that roughly imitate it.

Now, the way of St. Vitus' Dance, when school made (or, let me say, of that movement disorder which, if unheeded, culminates in that affection) is commonly this. At first the temper deteriorates, the child gets petulant, fretful, and capricious. With this will often concur headache and restless nights. And if these signs are not read aright, and school work is not relaxed, there arises presently a certain restlessness of the face and limbs. Even this may be easily overlooked, because children are by nature restless both in mind and body. But if you are on the watch, and warned already by the change of temper, or the headache, or the bad nights, you will soon perceive that this over-movement is not *merely* childish restlessness. You will find, for instance, that it applies particularly to one part, or to one limb; that while there is a general want of control, this is expressed most in one place, and *the commonest place* (except the face and tongue) *is the hand.*

This infirmity of the hand gives rise, of necessity, to manual faults, which at first almost invariably are taken for a wilful disobedience to school rules and commands. Anyone who reflects how much school work is hand work will feel pity for these poor children in the form that their visitation so often takes. It is easy to see how bad writing and untidy sums provoke scolding and slapping on the back; how these correctives in their turn increase infirmity, leading to worse writing and worse sums, until at length, by a self-acting process, the riot of the muscles become apparent, the child is put to bed, and its suffering ends.

The child's condition, I say, so long as the nature of it is unrecognised, is pitiable. Infirmity provokes punishment, and punishment aggravates infirmity. But I must add, speaking generally, that the child is not sorry for herself, nor resentful of injury. I suppose, indeed, that so long as the sums are being daily worked wrong, with daily slapping and "keeping in," while her schoolfellows, more observant than their teachers, ridicule her contortions and grimace, life must be regarded as something of a burden; but I know, as a fact, that once delivered from this tyranny, the St. Vitus' Dance child is, as a rule, a cheerful, amiable person, quite ready to see the ludicrous side of its own malady, very

sensible to kindness, and soon cured by it. Once in bed and at rest, the rational treatment of its infirmity supplies as many aids to recovery in the way of sufferance, praise, and encouragement, as there have been before hindrances in punishment, extra work, and the belief on the part of the child (as I have known) that she is really "possessed."

You are to observe, then, that this disorder which school anxieties provoke, which goes on for a length of time unnoticed, or else is put down to perversity, has in fact two distinct stages, or to speak more correctly, is looked at from two different points of view—the teacher's and the doctor's. At first, and at school, it is subjected to penal correction; and at last, when by these means it is fully developed, it is remitted to the doctor and given time for recovery. By a course of treatment which the most malevolent design could not better contrive to that end, the overtaxed school-child is converted into the helpless hospital patient. The case stands thus: when the disorder is first called into life, when it has weak hold and proper treatment founded on correct diagnosis (if I may use so large a word) would arrest its growth and nip it in the bud, it is supplied with the very food it wants for its development. At a later time, when fully grown, when no one can mistake it, and only time can cure it, it becomes a hospital "case," a fair text for comment on "modern school teaching."

Is there any remedy? Perhaps not. It is so difficult for any of us to enlarge by ever so little his accustomed range of observation. And, in my opinion, it would be better that the dance of St. Vitus should be cultivated in schools, as most certainly it now is, rather than that teachers should be in constant dread of it, allowing faults and relaxing discipline on its account, seeing it where it was not, magnifying both its frequency and its peril. St. Vitus' Dance is after all a comparatively small matter, and the terror it inspires is groundless. Yet no one will deny that we should be better without it.

In conclusion, therefore, I would put in dogmatic form the substance of what has now been said regarding the causes, the subjects, and the usual premonitions of St. Vitus' Dance, together with certain physical tests by means of which injurious schooling may be detected and disease averted:

1. Movement disorder is the product and the index of mental disturbance, and may be known by nice observation of the higher muscles (the face and hands) before it has reached the stage to which the term St. Vitus' Dance (or Chorea) properly applies.
2. When school children (and especially girls between seven and twelve, or thereabouts) alter in temper, work less well and less willingly than usual, get untidy or slovenly, in a word degenerate mentally and bodily, inquire of the mother as to the home conduct and temper. Ask particularly how the child sleeps, whether she complains of headache (or limb-ache), whether her food is sufficient.
3. Among the incidents of school-life apt to be injurious in the way we are considering there stand out prominently examinations,

moving into a higher class, sums (too difficult or ill-explained), punishment, and especially punishment or admonition before schoolfellows.

4. The best index of muscular infirmity tending to St. Vitus' Dance is *the hand.** Face mobility may be mere nervousness, the tongue may be tremulous by nature. The hand test is infallible, and it is thus applied. Bid the child hold up both hands open, with extended arms, the palms towards you. If that is done steadily, both hands upright and both alike, no finger or thumb quivering, no falling back of either hand, nothing to choose between the positions of the two, then the child has not, nor is it near (either before or after), St. Vitus' Dance. You may confirm this test by another. Let the child place its open hands upon yours, palm to palm. Looking then at the backs of the child's hands, observe whether fingers and thumbs (and especially the latter) repose naturally, without tremor and without restraint.

Appendix.

In 177 cases of St. Vitus' Dance, 43 were boys, 134 girls. This proportion, say one boy to three girls, will nearly express the sex incidence of the disorder, when all its causes are taken into consideration; but for school-made chorea, as the text shows, the proportion of girls is very much greater.

As regards age, the numbers run thus in the above cases:—

	Boys.	Girls.
Over 13 years	3	7
12 and 13 years	2	14
10 and 11 years	12	43
9 years	8	23
8 years or under	18	47
	43	134

It is clear, therefore, that the more sensitive sex furnishes the larger proportion by far of St. Vitus' Dance, while from 8 to 11 (the sensitive age) represents the period of greatest frequency.

St. Vitus' Dance is very rare under five years, the youngest patient I ever saw (if not the youngest on record) was one of my own, a girl aged 2 years and 11 months.† As proof of the commonness of St. Vitus' Dance it may be said that 100 children were admitted with it in about four years in my ward of 21 beds at the Hospital for Sick Children. The disorder is far less common out of London.

An analysis of 25 children under my own observation who exhibited movement disturbance due to some particular nervous overstrain will help to show in what degree school worry is directly concerned. In 16, the

* Photographs were shown, and also some children exhibiting the position of hand above described.

† Lancet, 1888, I., 109.

causes are definite sources of alarm for which school cannot be held responsible, *e.g.*, being "nearly run over," "chased" by men, women, boys, or dogs (several under such headings) "locked up in a cupboard," witnessing some alarming incident, quarrels, drunken violence, &c.

The remaining 9 of the 25 (or over a third) are directly connected with school: *e.g.*, overwork; punishment; preparation for examination, and so forth.

With a view to bringing home to those who are unfamiliar with the subject the precise manner in which school children are thus injured, together with the important fact (which some may be disposed to dispute) that children are often suffered to remain at school notwithstanding their movement infirmity, I will recall the circumstances of six months (November 1890 to May 1891) hospital experience in these respects.

During this time 40 examples of St. Vitus' Dance were admitted to the Hospital for Sick Children under my colleagues (Drs. Cheadle and Barlow) and myself. I quote the eight following, all but one are girls :—

1. *Florence P.*, age 11 years 9 months. (February 12 to March 2.) A second attack, (the first attributed to being "caned and knocked about at school") she has been worried over lessons, and observed to sleep badly. It was first noticed that she would drop things and was very restless both day and night. The restless nights preceded the movements by some weeks. On February 1st, the parents noticed in addition that the child had difficulty in writing, and *she was removed from school four days later.*

   This girl showed St. Vitus' Dance of moderate severity; quickly recovering on getting rest.

2. *George H.*, age 10 (the only boy on the list) (January 23 to March 26). As far back as November observed to be restless, *but not removed from school.* At Christmas much frightened by seeing a woman knocked down and her head cut open. Was much more restless the following day, screaming and crying out at night. *Was still kept at school* notwithstanding, and only last week was punished for inattention at lessons.

   This boy, though not very bad on admission, became violently agitated some time later after a dream, weeping and throwing himself about in paroxysms, quite beyond self-control, and fed with great difficulty. He was more than two months in hospital, but eventually made good recovery.

3. *Bridget M.*, aged 11 years and 7 months. 9th December, 1890 to 1st January, 1891. (Dr. Barlow's case.)

   For three months this child has been working for examination, and for two months has stayed in school until eight o'clock, doing home work as well. Lately has complained of headache. Worried herself especially about sums, fearing that she would not pass in arithmetic. The disorder increased to the degree of St. Vitus' Dance on the first day of the examination. It thus happened, that as the child sat writing her paper, the restless left elbow by misadventure jogged the writing hand of a boy sitting next her, and helped to spoil his work. She was much upset by this accident, and the movements increased. On admission, the limb movements were not considerable, but the child was unable to walk, and had difficulty in bringing out words. She recovered well.

4. *Gertrude MacS.*, aged 11. April 28th to May 21st. (Dr. Barlow's case.)

   This was the second attack, and had begun three weeks before admission after she had been in for examination. The disorderly movements were first noticed during writing; they afterwards became general.

5. *Rosa W.*, aged 9 years and 9 months. March 19th to April 23rd.

   General restlessness and difficulty of speech, not due to schooling in the same sense as the preceding, but to the

excitement produced by taking part in a school concert. (Dr. Barlow.)

6. *Kate P.*, aged 10 years and 2 months. February 27th to April 2nd.
   Has been working hard for June examination. "Hardly sleeps at all." The movements have been noticed a month, beginning in face, twitching of eyelids and mouth. *For the first week, however, she was kept at school.* On admission the movements were severe, and the girl could not feed herself. The case was of some endurance, but recovered perfectly.
7. *Edith C.*, aged 9 years and 5 months. November 7th to December 11th. (Dr. Cheadle's case.)
   Alleged cause "much worried with lessons at night, and finds difficulty in preparing them." Attention was first drawn to the child's unsteadiness in holding things a fortnight ago. Her walk was next observed to be irregular, and the corners of the mouth twitched. (The case is an example of a mode of the disorder, namely, stumbling gait, very apt to be overlooked.)
8. *Myra M.*, aged 8 years 7 months. April 22nd to May 26th. (Dr. Cheadle's case.)
   Has been working hard at school for six or eight months ("overworked," says the mother). Four months ago she woke up screaming, and for a time did not recognise her mother. But nothing further was noticed until six weeks ago, when limb movements and defects of hand grasp were noticed. *She was kept at school, notwithstanding, for three weeks longer*, during the latter part of which time her speech began to fail, and she became "stupid." A moderate general chorea; making good recovery.
9. *Amy A.*, aged 8 years 6 months. December 1st to January 3rd. (Dr. Cheadle's case.)
   Admitted for general movements of head, arms, and legs, with speech difficulty, the cause assigned being worry about school examination. (This patient died of an independent disease, the St. Vitus' Dance subsiding. The case is introduced to complete the list of those attributed directly to school causes within the period mentioned.)

The points to be specially noticed in the foregoing list are these:—

1. Only one of them is a boy, and with him a special alarm was a contributing cause.
2. There was school worry in all the cases except one (No. 5) where there was the injurious excitement of performance at a school concert.
3. In no less than five the children were kept at school after their limb disorder had been noticed.
4. In three of the severest cases the excitement of examination was a prominent feature of the provoking cause.

DISCUSSION.

Dr. Cheadle in supporting the views enunciated in Dr. Sturges's paper, pointed out that it was not so much hard work in itself which was effective in producing St. Vitus's dance, as the excitement, emotional disturbance, anxiety, and dread which resulted from inability to do school work, and the punishment and disgrace which accompanied it. This condition, as Dr. Sturges pointed out, was liable to go from bad to worse, as inability increased, and increased punishment followed. Dr. Cheadle related an example in which chorea followed great excitement, although previous hard work had not produced it. He could not agree with

Dr. Sturges as to the small importance of chorea; although in itself not generally a dangerous disorder, it was frequently associated with heart disease and rheumatism; and grave heart disease often began in the early stages of chorea. Therefore he thought it of great importance that the disease should be recognised and dealt with at once, before serious consequences arose, and Dr. Sturges had done good service in calling the attention of school managers and teachers to the first signs by which the approach of the disorder might be recognised.

Ringworm in Elementary Schools.

BY

MALCOLM MORRIS, F.R.C.S.E., Surgeon to the Skin Department, St. Mary's Hospital, London.

It is seldom that such an opportunity offers itself for the medical man, sanitarian, and educationist, to meet on a common platform as is offered by this special section of the Congress, and it is a matter for congratulation that the section is presided over by one whose knowledge of elementary education is probably unique. I have therefore availed myself of this occasion to express my views on a certain aspect of a disease of the skin, which, unfortunately, is extremely common in this country. I am unable to produce trustworthy statistics of the proportion of children attending elementary schools who suffer from ringworm, owing to the obvious difficulties of investigation; but I can, from personal experience derived from prolonged observation in the out-patient department in one of the large London general hospitals, and from confirmatory statements of colleagues at other hospitals, vouch that ringworm is far commoner in London than in any of the continental cities with which I am familiar. Although it is not my intention to dwell upon the medical side of the question at any length, it is, nevertheless, necessary to say a few words about the nature of the disease in order to elucidate the subject.

Microscopic examination, cultivation, and inoculation experiments, incontestably prove that all the phenomena of the disease, however varied in their clinical manifestations, are due to a fungus which invades the various layers of the epidermis. This fungus consists of mycelium, representing the mature elements, and spores—so to speak, the seeds — which latter, either by personal contact, or through the medium of the atmosphere, are capable of transplanting the disease on a suitable soil. The extreme contagiousness of the malady, which is familiar to everyone, is thus accounted for. Many of the perplexities which arise are due to the difficulties in recognising its earlier manifestations, which are too often regarded, both by parents and school authorities, as merely "scurfy heads." The same remark

applies very often to the disease in its later stage, when cure is supposed to have been effected. When ringworm attacks the body it is quickly and easily eradicated, as the fungus lies quite near the surface. It is, therefore, only with ringworm of the scalp that I am concerned in this paper. Here its obstinacy to treatment is due to the anatomical fact that the fungus is present, not upon the surface of the skin only, but also around the roots of the hairs in the deep hair-sacs or follicles. This fully accounts for the difficulty in effecting anything like a rapid recovery, even in most favourable circumstances; while among the poor, owing to indifference, lack of time, and skill, the disease is certain to last for many months, and not infrequently for years. In this respect it shows a marked contrast to all the other contagious skin diseases of children, as, for example, scald head, the itch, and other animal parasitic disorders, which yield quickly to suitable treatment. The question now arises, What is the present attitude of the authorities with regard to the disease? To this no satisfactory answer can be given, as no line of conduct is uniformly pursued.

On the one hand, the schoolmaster who is watchful and zealous as to the physical well-being of the children under his charge refuses to admit a child with ringworm to his school; whereas, on the other hand, he who is lax is apt to overlook or minimise the importance of the disease. In both cases, in my opinion, a grievous injustice is committed, for in the former case, a child, presumably in good health, is banished from school and all its advantages, both moral and educational, for a prolonged period, at a time of life when these are essential for its well-being. In the second case, the spread of the disease to other children is inevitable, and the community at large as well as the individual children must suffer. Of these alternatives, from a medical point of view, the former is the only logical course, though its effect must of necessity be a marked diminution in the general standard of national education and the reduction of the educational returns. It can hardly, I think, be questioned that it is the duty of the State to remedy this, and I would suggest the following practical recommendations as the only ones which have suggested themselves to my mind as offering any solution of the difficulty. It is clearly necessary, before attempting to cope with the disease, that the exact extent and frequency of its occurrence should be estimated. This can only be carried out by means of ***systematic inspection***, in order to accomplish which persons should be trained in each school by skilled medical men to make a weekly examination of every child's head. By this means alone trustworthy statistics would soon be obtained. My second recommendation is directed towards the eradication of the disease without interrupting the educational progress of the child. In the more crowded districts, or wherever feasible, special schools ought to be established in which both systematic treatment and instruction could be carried out. In less populous districts a single class-room might be isolated with a separate entrance. If such a system could be enforced, the advantages would be that the education returns would at once show a marked improvement, that the children

would no longer be deprived of their just privileges of education, and that ringworm would be materially diminished in this country, if not entirely eradicated.

DISCUSSION.

Dr. T. Calcott Fox observed that there are three facts that must be kept steadily in view in discussing this question. Firstly, there can be no doubt that ringworm is excessively common amongst the children in London; secondly, that the disease is propagated for the most part by contagion from head to head by actual contact, by interchange of caps, and so on; thirdly, that when once the growth of the fungus is firmly established, the disease is excessively obstinate, and may not be eradicated for months or even years. Conclusive evidence could easily be adduced to show that the aggregation of children in the elementary schools is a fruitful source of contagion. Whether ringworm has increased in frequency of late years is a problem which need not detain us to-day. Now it is obvious that on the one hand children are deprived of education for lengthened periods, and on the other hand many cleanly children are infected at the school, often through no fault of their own or of their parents, and this leads to unpopularity of the schools. This contraction of ringworm is an unfortunate incident of school-life, and all the more regrettable that the industrious and well-cared for children and the idle and neglected suffer indiscriminately. However painstaking and cleanly a mother may be in tending her children she can never be secure against the infection whilst they are attending school. I do not know what instruction the teachers may receive from the authorities, but my experience goes to show that there is an absence of any systematic and careful method of dealing with this disease in schools, and this irregularity leads to considerable hardship. Some teachers are certainly careful, and keep a watchful eye on the occurrence of ringworm, and at once exclude the victims or send them for examination to the hospitals. Many children are thus kept away from school for long periods, which depends on the zeal and energy of the mothers. But even in such schools which are comparatively free from ringworm, only conspicuous cases are recognised, and the earlier stages pass unnoticed for considerable periods. In other schools the teachers, with their hands full of other business, do not trouble themselves much about the matter.

What, then, is the best method of dealing with the problem? Experience of many of the educational establishments for the children of richer people shows that ringworm can be effectually kept away. But this necessitates, firstly, the assurance that no infected child enters into the establishment; and secondly, a rigorous and constant supervision of the children. The elementary schools of London could by such means be kept free from ringworm, but on the one hand there would be a great number of excluded children who must undergo a cure somewhere or other, and who meanwhile are deprived of education; and, on the other hand, to attain the object in view an expert staff would be required to examine all the children at the opening of the school after the holidays and at stated times afterwards. No doubt a medical staff would be the most satisfactory, but a staff of specially educated nurses would probably be fairly effective and less costly. The infected children could be sent to the most conveniently situated dispensaries and hospitals, where a

suitable course of treatment could be arranged, but as the rapidity of a cure depends so much on the energetic and faithful carrying out of the treatment, I would suggest as most desirable the supervision by a visiting trained nurse.

Meanwhile, what is to be done about the education of these infected children? They might either attend school and be taught in a separate room, which would be very inconvenient, and their attendance would be probably irregular. The only danger of infection would be on returning from school, but this difficulty could easily be overcome. Or they might be isolated by a residence in a separate establishment, where both treatment and education might be carried on. This alternative would be resisted probably by many parents, and would be costly.

The only other alternative, and much the simplest, is to educate the infected children with the others, but to carry out a partial isolation in the schoolrooms, and insist on suitable precautions being taken as to the mingling of the children, effective treatment, and the wearing of proper protection of the heads. I do not think that there would be much danger of infection under these conditions, and certainly as regards cost and efficiency of education, I think this plan the most practicable.

The course I would recommend for adoption is as follows:—I. That a systematic inspection of the school children should be carried out by a staff of medical men or by specially-trained nurses at the beginning of term and at stated intervals afterwards. II. That the infected children should be sent to a convenient hospital or dispensary for a course of treatment to be prescribed. The cure would be much expedited if nurses could assist and supervise those in charge of the treatment. III. That the children should still attend the schools, but be isolated as far as possible in the schoolrooms; that they should have their heads properly treated with germicide applications, and be covered with suitable caps to prevent any dissemination of the fungus; and that they should be discharged from school before the other children to prevent intermingling.

Epidemics in Schools.

BY

C. E. SHELLY, M.A., M.D., Cantab., Consulting Medical Officer to Haileybury.

The connexion between schools and epidemic disease presents at least three important aspects. A school is peculiarly liable to the incidence and extension of such maladies; it presents special opportunities for their investigation; and epidemic illness is particularly important to both the school authorities and to the parents of the pupils, because of its interference with the health and with the education of the latter.

Schools are peculiarly susceptible to any epidemic influences, because they are closely aggregated populations of young people of whom an unusually large proportion (as compared with an equal number of the general population) is unshielded by the protection commonly afforded by a previous attack of the malady in question. The child at school is

not, as an individual, more susceptible than the same child at home, but while at home it exists as one unit of the general population, the susceptibility of which is greatly diluted by the intercalation of numerous other persons, of all ages, whose personal intimacy is much less close, and most of whom, being already protected by a previous attack, are not readily transformed into personal foci of infection. In the school itself, however, these conditions are reversed:—the susceptible material is concentrated and in relative excess, it is peculiarly liable to attack, and infection, howsoever originated, has a field specially favourable to its incidence and its extension.

The evolution of a specific type of disease from ancestral germs originally indifferent is not impossible, but the theory is as yet unproved. And, if its probability be admitted, we have no evidence to warrant us in applying it more to schools then to other collections of humanity, and least of all, if (as should always be the case) the school and the school-life be healthy. Other and reasonable explanations are abundantly to hand. And if the premises, the administration, and the daily economy of the school are in accordance with hygienic rules, it is quite justifiable, in the present state of our knowledge, to assert that whenever epidemic illness arises in a school it has always been imported. Indeed, the avenues of infection from without are so many and so varied that it is humanly impossible to safeguard every one of them.

From the nature of the case special facilities exist for this importation of disease; thus:—1. While at home, the child is brought into contact with the outer world of "all sorts and conditions" of men, women, and children, much more frequently and more intimately than is the case while it lives at school. Day scholars spend from four-fifths to three-fourths of their lives away from school, *i.e.*, frequently exposed to the risk of infection. And the pupil at a boarding school similarly spends at least three months out of every twelve in holidays and exeats.

2. But while at school—even as a boarder in an establishment constituting a relatively isolated community in a sparsely populated country district—there are still many points of connexion with the world outside: letters, parcels, clothing, "hampers"; the visits of tradespeople, and to shops, &c.; communication with servants; and, at the beginning of each term, an intimate association with the numerous other pupils—each, perhaps, a freshly arrived representative of another family elsewhere—with all its possibilities of contracting and transmitting infection; besides the possibility of inhaling or imbibing infected air or water in the neighbourhood of the school, for the best school cannot control its neighbours, or absolutely secure its pupils against the results of other folk's defective sanitation.

3. By far the most potent influence, however, so far as regards the commoner epidemic ailments at all events, is that dependent on the fact that so large a proportion of young school children is unprotected by any previous attack of the infectious diseases to which they are from time to time exposed during subsequent years. This is due, in the first place to the circumstance that, during the earlier years of life (infancy, early childhood), the individual's world is practically its home; it

mixes, in fact, less in society than it does when older; its points of common contact with the world at large are fewer; and it is subjected to greater personal care and supervision, the result of all these influences being a relatively effective protection from the risks of infection. It might be theoretically anticipated that this parental guardianship would be effective in proportion to the spread of hygienic knowledge amongst the population generally; and this theoretical assumption is corroborated by the results of somewhat extended observations. A large number of public and other boarding schools have furnished data on this head derived from an analysis of the facts which are recorded on the health certificate which is filled up by the parents or guardians of each pupil at the time of his entrance into the school. Subjoined is a Table (A), compiled from the statistics of one such school which has been selected, not because its results are the most striking, but because its carefully kept records extend back over a longer interval of time than do those of any other school with which I am acquainted.

TABLE A.

	I.	II.	III.
Statistics for	Sixteen years, 1863–79.	Eight years, 1879–87.	Twenty-four years, 1863–87.
Boys entered -	1,639	959	2,598
*Un*protected by a previous attack of—	1863–79.	1879–87.	1863–87.
Variola - -	1,624 or 99·08 %	955 or 99·5 %	2,579 or 99·2 %
Scarlatina -	1,183 or 72·18 „	718 or 74·86 „	1,901 or 73·57 „
Rubeola - -	382 or 23·3 „	283 or 29·5 „	665 or 25·79 „
Pertussis - -	448 or 27·3 „	285 or 29·7 „	733 or 28·02 „

These statistics cover the period 1863–87. If the 24 years be divided into three equal periods of eight years each, but little difference is observable between the first and second of these epochs. And the combined returns for the first sixteen years, 1863 to 1879, are therefore grouped together in column I. It will be at once noticed that this column contrasts with that for the last period of eight years, 1879 to 1887, in the decided increase of the *un*protected which is observable in the latter period. Had this been confined to such a disease as measles, it might have been explained on the supposition of the more general and more careful differentiation between this malady and Röthelu ("German measles"), which has obtained among both the medical profession and the public during recent years. But this increase of the unprotected obtains in the case of each of the maladies enumerated, and one is compelled to the conclusion that it is really due to an increasing education of the public in general hygiene;—an increasing education,—

because the returns from this and other large schools for the last four years (*i.e.*, since 1887) give evidence of a still further slight and continuous rise in the proportion of the unprotected. In other words, owing to more careful prophylaxis at home, and to the earlier recognition of, as well as to the prompter and more efficient isolation of "first cases,"—a larger (and an increasing) proportion of school children escape the incidence of epidemic illness during infancy and early childhood; *i.e.*, in the pre-school age, fewer contract these maladies than was formerly the case; and a greater number, therefore, enter school unprotected.

To the medical officer of health and to the family doctor such a result may be a legitimate cause of satisfaction; but it does not lessen the responsibilities of the masters or of the medical officers of schools; and it cannot be regarded as tending to reduce the minimum of hospital accommodation required by a school. This progressive increase in the proportion of the unprotected at the beginning of school-life has obtruded itself upon my notice in several other ways in the course of investigating this and kindred questions. Thus, for example, in a large preparatory school (350) to which only *young* boys are admitted, the entrance age was, some years since, raised by 12 months; but the average ratio of the unprotected (from measles, for example) now stands practically at the same figure as formerly; and this, despite the fact that 12 months of age, more or less, makes a very notable difference in the returns for any yearly period between the ages of 9 and 12.

As might well be supposed, results such as those which have just been considered, are most notable in the higher strata of society,—amongst that section of the community which, in addition to natural intelligence and education, is in a position to command physical, moral, and sanitary advantages which are often beyond the reach of their more ignorant and less prosperous neighbours. The returns from schools of markedly different social status present, in this respect, most striking and instructive variations (*vide* also Table B, *post*). Moreover, it is almost self-evident, and is clearly shown by such returns as those given in Table B, that the child's liability to infection will tend to decrease with its advancing age, in proportion, in fact, as one epidemic malady after another attacks it and confers its own quantum of immunity.

4. Day schools present conditions even more favourable to the incidence of epidemic infection than does ordinary home-life; for, at such a school, each child has specially frequent opportunities of association with a number of other children, and each of these latter is exposed to specially frequent and diverse risks of infection. Hence, the day school is much more open to attack than is the boarding school. But comparing day and boarding schools for children *of the same age*, outbreaks of epidemic illness will, indeed, be more frequent in the former; but each epidemic is apt to be relatively less extensive; because, in the day school, owing to the very frequency of recurrent epidemics, a relatively smaller number of pupils are, at any given

i p. 2124.

time, unprotected by a previous attack of the disease in question; conflagrations, as it were, occur with frequency, but they are comparatively limited in extent, because so much of the town is always already 'burnt out.'

5. For reasons similar to those considered above, the attendance of day-scholars at a boarding school greatly increases the number of avenues by which infection may be introduced. In other words, the frequency of epidemic outbreaks is increased, while their relative extent is thereby proportionately diminished.

6. The boarding school proper is the most isolated community of this class. By the exercise of due precautions, epidemics may for long be kept at bay. But during this period of freedom from such forms of illness, the proportion of unprotected pupils in the school is rising; and when, at last, infection is introduced—as, sooner or later, it is bound to be—there is a large amount of susceptible material open to its influence, and comparatively few barriers—as represented by already protected individuals—to delay or stay its progress. Epidemics, in short, are relatively infrequent, and consequently more extensive when they do occur.

In all respects, then, the more isolated and self-contained community—the boarding school—affords a typical field for the study of epidemics in schools; and it is to this class of school, and more particularly to boarding schools for boys, that the following remarks will especially apply.

The establishment and the spread of an epidemic are favoured mainly by two conditions—which are of practical importance because, given certain simple data which ought to be easily obtainable in the case of every boarding school, it is possible (for some diseases at all events) to calculate their value and to forecast their effect with a reasonable approximation to substantially accurate results.

These two conditions are :—

First.—The close aggregation of susceptible material, as represented by pupils who are *un*protected by a previous attack of the particular epidemic disease under consideration. The amount of susceptible material which is present in any given case is proportionate, mainly, to the *age* of the scholars; *i.e.*, practically, to the number who are or are not already protected by a previous attack. It is generally recognised that, for most of the commoner epidemic illness—measles, scarlatina, whooping-cough, Rötheln, mumps, and chicken-pox, for instance—one attack confers on the sufferer a very considerable degree of immunity against a recurrence of the same malady. It would not be unreasonable to surmise that *some* degree of immunity (more or less complete, and lasting for a longer or shorter time in different cases) is conferred by an attack of *any form of* infectious disease. The modern theories of the ætiology and pathology of this class of disease are in accord with such a surmise; and experience is also in its favour, for the apparent exceptions are only relatively exceptional. An attack of diphtheria, for example, does not protect the sufferer from a second or third experience of that disease to anything like the same extent that obtains in the case

of scarlatina or of measles. But a close examination of the two cases reveals the fact that the difference is one of time rather than of degree. For it is extremely rare to find an individual suffering from a second attack of diphtheria soon—or, indeed, for some time—after recovering from a first attack, even though throughout his illness, and subsequently, he remains exposed to precisely the same conditions as those which surrounded him for some time before its commencement. The modifying influence exerted upon the life-processes of the patient, may be, so far as is known, equally profound in the two cases; but this effect is usually much more lasting in the one disease than in the other. Reduced in health though he may be, the convalescent from a common cold, even, seldom contracts another immediately, in spite of his continuing to live on terms of the closest personal intimacy with the other suffering members of the household through which "the cold is running." On the other hand, we meet, every now and again, with individuals on whom a severe attack of scarlatina or of small-pox confers but a slight or short-lived protection against a repetition of their illness. It may be concluded, then, that *all* infectious and epidemic diseases are (for different periods) self-protecting; and we may regard an attack of any such disease as a natural form of prophylactic inoculation, affording a protection whose duration varies, between wide limits indeed, for the several maladies included in this large class.

For the present, however, we are concerned with those common maladies, a first attack of which is generally acknowledged to afford immunity, usually both absolute and prolonged, against a second. And, during the earlier years of life, this immunity stands in an inverse ratio to the *age* of the individual, because, with increasing age come increased opportunities of infection, with a resulting increase in the amount of protection thereby ultimately conferred.

Table B shows returns obtained from 13 large public and private schools. The schools are arranged in the order of the age of the boys at entrance; with the one exception—A, to be noted presently—they are all on a fairly equal footing as regards social status; and it will be observed that (with this exception), and so far as their statistics are obtainable and reliable, *age* constitutes a very fair basis for estimating the liability to infection for the several diseases mentioned. But, modifying the all-important factor of age, is to be noted the potent operation of social position. Contrast, for instance, A and B. The former is a school which, by the very terms of its existence, is largely recruited from families that have been visited by misfortune or broken up by disease and death. Children come to it, therefore, at the age of about nine, from conditions which have been, on the whole, *not* the most favourable to the safeguarding or the preservation of health. No infectious malady, perhaps, spreads more readily under such circumstances than *measles*, and the per-centage of those already attacked by that disease is 67. B is a private boarding school; its pupils all come from families occupying a good position in life, and in affluent circumstances. Every care is possible, and has, no doubt, been

TABLE B.

School.	Average Age at Entrance.	Per-centage of Boys who enter unprotected by—					
		Scarlatina.	Rubeola.	Rötheln.	Mumps.	Pertussis.	Varicella
A	8–10	82·3	33·1	94·7	85·2	41·8	58·6
B	10½	80	65	80	60	30	40
C	11	70*a*	45*a*	70*a*	70*a*	33*a*	50*a*
D	11½	?	?	?	?	?	?
E	9–14	75·9	27·8	?	74	42·7	?
F	12	72·35	23·53	?	75·9	40	52·9
G	12	?	?	?	?	?	?
H	13	67	19	?	?	31	?
I	13	?	?	?	?	?	?
K	13	?	?	?	?	?	?
L	13½	80	24	?	?	32	?
M	13½	74–86	29·5	?	?	29·7	?
N	14½	75	16·9*b*	96·9	72·6	43·4	55·1
O	19	8	3	10	10	15	10

a, "Approximate" returns. *b*, Boys come chiefly from other large schools.

rendered to them individually at home from the very moment of their birth; and, moreover, they enter this establishment direct from home, without having gone through any preparatory school. Hence, although their average entrance age is at least a year and a half above that of A, and probably equal to that of E, only 35 out of every 100 have already had such a disease as measles.

The returns in this table are not so full or so complete as I could wish, or as such schools ought to be able to furnish if only the real value and importance of careful and systematic records of school illness were duly recognised. With respect to F, for instance, the relatively small number of those returned as "unprotected" by measles is striking; and one cannot help suspecting that some boys may have been said by their parents to have had measles, when what they had really suffered from was Rötheln; the figures (23·53 *per cent.*) are barely more than half those for whooping-cough (40 *per cent.*) instead of equalling them; and I find also, that in an epidemic of measles at this school, the number of pupils attacked would indicate a higher entrance rate of the unprotected (*vide post*, page 39). A similar suggestion applies to H; where, also, the average proportion attacked

in measles epidemics corresponds with that shown by schools in which the unprotected at entrance number 25 to 30 *per cent.* N shows a small per-centage in this column (16·9 *per cent.*); but its pupils "come chiefly from other large schools," and have, therefore, been already exposed to a double ordeal before they are drafted into this establishment, which occupies a special educational position. For O the entrance age is 19 years; its entrance statistics remind us how thoroughly a disease such as measles works during early adolescence; and show, too, what a large proportion of young adults have already suffered from scarlet fever—as individuals, at all events—though of boys *æt.* 15, less than 50 *per cent.* have had this disease.

The other cause which, in conjunction with the influence exerted by the average age of the pupils, favours the outbreak and spread of an epidemic, depends on—

2. The existence of a certain proportion between the number of unprotected—and, consequently, susceptible—pupils, and the *total* number of pupils in the school. This particular proportion may be termed "the explosive ratio," and its precise form varies with the particular epidemic disease which it represents. Both the risk and the probable extent of a conflagration in a building vary with the amount of its combustible contents, and with the extent to which this is diluted, by intimate admixture, with non-inflammable material. If a number of cartridges, some loaded and some empty, were jumbled together in a box, not stored in a magazine but exposed to the incidence of any casual spark, the probability of an explosion would have an intimate relation to the proportion existing between the number of loaded cartridges and that of the harmless empty ones that had been already fired. This simile fairly represents the conditions obtaining in the average school and its liability to outbreaks of epidemic disease. For, just as the empty cartridge cases, though not themselves explosible, might smoulder and thus lead to the ignition of their loaded fellows, so a child already protected by a previous attack of the disease, though unlikely to again fall ill with it himself, might convey its infection—by means of his person or his clothing—from one patient to some other still susceptible schoolfellow. And, moreover, just as it might be of service to know at any given time, the proportion existing between the loaded and the empty cartridges, in order to estimate the probability and the force of an explosion, so it is, in many cases, both possible and serviceable to be able to forecast the probable date and extent of inevitably recurrent epidemics, if we can but ascertain the ratio which exists between the number of the already protected and of the still susceptible pupils in a school.

In Table C an attempt has been made to show what relation exists between the age and unprotected ratio at entrance on the one hand, and the average total attacked in an epidemic of each of the diseases named, but most of the returns are too fragmentary or incomplete to furnish more than suggestions.

Table C.

School.	Average Entrance Age.	Scarlatina. Per-centages.			Rubeola. Per-centages.			Röthein. Per-centages.			Mumps. Per-centages.			Pertussis. Per-centages.			Varicella. Per-centages.			Total Boys in School.	These are Statistics for the last
		UE.	Mx.	Av.	UE.	Mx.	Av.	UE.	Mx.	Av.	UE.	Mx.	Av.	UE.	Mx.	Av.	UE.	Mx.	Av.		
A	8–10	82·3	12·5	2·63	33·1	23·75	22·1	94·7	28·0	21·67	85·2	42·6	29·03	41·8	13·12	3·5	58·6	13·3	6·55	340	10 years.
B	10½	80*a*	1·6		65	25	21·6	80	54		60	48		30	?	?	40	36		60	12 years.
C	11	70*a*	1·6	1·08	45*a*	27·6	25·5	70*a*	?	?	70*a*	48·6		33*a*	?	?	50*a*	?	?	182	9 years.
D	11½	?	4·17	3·58	?	11·06		?	0	0	?	0	0	?	0	0	?	0	0	768	17 years.
E	9–14	75·9	0	0	27·8	22·5		?	0	0	74	0	0	42·7	0	0	?	0	0	400	5 years.
F	12	72·35	0	0	23·53	20		?	?	?	75·9	?	?	40	?	?	52·9	?	?	200	?
G	12	?	7·1*		?	20*		?	30*		?	30*		?	5*		?	3·3*		300	?
H	13	67	0·017		19	14·9	14·78	?	25·26		?	12·45	10·69	31	?	?	?	1·05	0·52	570	6 years.
I	13	?	1·0	0·4	?	14·4		?	40·4	26·7	?	?	?	?	0·6		?	0·4	0·3	500	3 years.
K	13	?	2		?	"about 10"		?	"about 10"		?	2·5		?	?	?	?	2·5		400	?
L	13½	80	4·7	1·7	24	24·7	14·5		?	?	?	?	?	32	?	?	?	?	?	400	15 years.
M	13½	74·86	2·0	1·2	29·5	15·7	13·8	?	22·6	20·1	?	18·2	8·2	29·7	1·0		?	3·8	1·4	500	12 years.
N	14½	75	0	0	16·9	7·4		96·9	9·09		72·6	20·9	20·8	43·4	0	0	55·1	28·5		118	5 years.
O	19·	8	3·1		3	5·6		10	4·9		10	5·6		15	0	0	10	0	0	124	5 years.

Under the head of each disease is given (1) the *Per-centage* of boys who are, at entrance, *un*protected by a previous attack, = UE.; (2) the *Maximum* per-centage (calculated on the total number of boys in the school at the time) attacked in an epidemic = Mx.; (3) the *Average* per-centage attacked in "full-scope" epidemics = Av.
a, "Approximate." * "These figures from memory."

Table D is of more value because it represents the carefully kept records of epidemics in a large school as observed throughout a quarter of a century. Boys enter this school at about 13 years of age, at which time nearly 75 per cent. are unprotected by any previous attack of scarlatina, and about 30 per cent. have had neither measles nor whooping cough.

Table D.—Epidemics.

Scarlatina.

Number attacked	1	1	5	9	5	8	23 [1]	1	1	15 [2]	7	2
Number in school	300	300	300	326	362	359	357	353	352	356	354	495
Percentage -	0·3	0·3	1·6	2·7	1·3	0·83	6·0	0·28	0·28	4·3	2·0	0·4
Rötheln—Percentages	2·5	0·26	0·82	3·1	4·10	5·74	3·08	22·6	17·6			
Mumps „	1·6	4·1	9·8	2·24	6·26	3·6	4·6	18·2 [3]	2·8	4·8		
Pertussis „	From 1·3 to 3 per cent. of total boys in school.											
Varicella „	0·82	1·6	1·36	2·1	1·25	3·1	3·08	0·52	0·6	3·8	1·0	

Rubeola.

—	Jy. 1867.	Jy. 1868.	April 1870.	April 1871.	Dec. 1873.	Jy. 1875.	Jy. 1881.	Jy. 1883.	Jy. 1886.
Number attacked	52	25	33	14	35	47	58	71	77
Number in school	316	358	358	359	363	359	498	496	496
Proportion -	$\frac{1}{6}$	$\frac{1}{14}$	$\frac{1}{10}$	$\frac{1}{25}$	$\frac{1}{10}$	$\frac{1}{7}$	$\frac{1}{8}$	$\frac{1}{7}$	$\frac{1}{6}$
Percentage -	16·4	7·0	9·2	3·9	9·3	13·1	11·7	14·3	15·7

[1] Special local cause active at the time. [2] Ambulant "Desquamator."
[3] Began during the Measles Epidemic of 1883, and ran concurrently with it.

Now *measles* is essentially the type of an epidemic disease which, being infectious in its pre-eruptive stage, cannot be stamped out by the isolation of first cases; it therefore furnishes, as a rule, extensive epidemics which run a generally uniform course, and consequently afford special opportunities for comparison and study. I have, for this reason, accorded a special sub-table to Rubeola, and a study of its figures shows that (omitting the outbreaks which, beginning late in the term, for instance, did not have opportunities of attaining their full dimensions) we get a total of 338 cases amongst 2,523 boys—*i.e.*, 1 in every 7·4 boys, or 13·4 *per cent.* for the whole 24 years. The first period of 16 years (when the unprotected entry was 23·3 *per cent.*) gives 132 cases amongst 1,033 boys—*i.e.*, 1 in 7·8, or 12·8 *per cent.* The last period of eight years (when the unprotected entry was 29·5 *per cent.*) gives 206 cases amongst 1,490 boys—*i.e.*, 1 in 7·2, or 13·8 *per cent.* This result conforms to that indicated in Table C, which also shows that when the *maximum* age of entrance into a school does not exceed 12 years, fully 25 *per cent.*, or one-fourth of the whole school, will probably be attacked in any "full scope" epidemic of measles.

Investigation from another standpoint indicates that measles epidemics are prone to occur whenever the susceptible material has so accumulated as to represent about one-third of the total number of pupils in the school at the time, or $\frac{T}{3}$. We have, then, two "empirical laws":

I. "*An epidemic of measles may be looked for whenever the total "number of unprotected boys equals one-third of the total number in "the school*"—(*i.e.*, when the susceptible material is so concentrated as to form a readily explosible mass).

II. "*In such an epidemic (if it have full scope, by beginning, "for example, early in a term) three-sevenths of the nominally "unprotected** (*i.e.*, $\frac{3}{7}$ of $\frac{1}{3} = \frac{1}{7}$ *of the total boys*) *may be expected "to be attacked.*"

These two laws may be thus combined:—*Let* T *stand for the total number of boys in a large school, the entrance age to which is about thirteen years. When* $\frac{T}{3}$ *are nominally unprotected by a previous attack of measles, an outbreak of measles may be expected to occur; and in this outbreak* $\frac{3}{7}$ of $\frac{T}{3}$ $\left(= \frac{T}{7}\right)$ *will be attacked.*"

[I may add that, as regards Rötheln, three-fifths of U T will probably be attacked—U being the co-efficient of *un*protection, *i.e.*, $\frac{1}{3}$, $\frac{1}{2}$, &c., as the case may be: perhaps for rötheln U may generally be taken $= \frac{1}{3}$, and then $\frac{3}{5}$ of $\frac{T}{3} = \frac{T}{5}$ or 20 *per cent.* = the number likely to be attacked in a full-scope epidemic of German measles.]

As a corollary it may be stated that—

III. "If the epidemic prove much less extensive than it should have been by Law II. (owing, *e.g.*, to its beginning about the middle or towards the end of a term), the next epidemic may be looked for after less than the usual interval," *i.e.*, as soon as the "explosive ratio" $\left(\frac{T}{3}\right)$ is again reached. I believe that this outbreak of an epidemic whenever the susceptible material reaches a certain proportion of the whole mass explains the commonly admitted tendency to the recurrence of the disease in schools at pretty regular intervals of time.

These empirical formulæ have been deduced from a study of the statistics furnished by numerous schools. The records furnished by one school in particular happen to be the most complete and extensive, though not, I think, more conclusive than the others; and I therefore reproduce a partial summary of them here. In a school of 500 boys,

* The "nominally unprotected" are those who appear to be unprotected according to the returns (entrance-certificates, &c.) commonly accessible.

who enter *æt.* 13 *circ.*, and leave *æt.* 18 *circ.*, the period of school life averages five years. About 100 boys enter annually, and of these, at least 25 per cent. are unprotected from measles; 100 boys leave every year, and of these, at least 5 per cent. will still be unprotected. So that in round numbers, 20 boys are added every year to the rubeola-unprotected population of the school. [Probably, *vide* Table I., it would now be more accurate to take a higher net percentage of unprotected; but the difference may be allowed to stand as a set-off against those few individuals who (while not recorded as such) become protected by attacks contracted and sustained during the holidays.]

Looking at the figures given under measles in Table D, RUBEOLA, it is seen that the chief epidemics occurred at intervals of about two to three years. When an interval of about 12 months only intervenes between successive outbreaks, the second epidemic is apt to assume comparatively small dimensions; *e.g.*, 52 cases $\left(\frac{T}{6}\right)$ in 1867, followed by only 25 $\left(\frac{T}{14}\right)$ in 1868; 33 cases in 1870, 14 in 1871. When the interval extends to about three years, the normal proportion $\left(\frac{T}{7}, \text{ or 14 per cent.}\right)$ tends to be assumed. This comes out more clearly on further analysis. In 1867, 105 boys, or about $\frac{T}{3}$, were *un*protected (U) by a previous attack of measles; 52 $\left(= \frac{3}{7} \text{ of U}\right)$ are protected by the epidemic of that year, leaving 53 still unprotected. Add 16 for unprotected entries in 1868, and we have a total of 69 U, of whom 25 become protected by an imperfect epidemic, leaving 44 U. Add another 16 for 1869, and 20 for (the larger entry of) 1870, and the total of 80 U is attained. An epidemic now protects 33 $\left(= \frac{3}{7} \text{ of U}\right)$, leaving a balance of 47 U. Add 20 for 1871, and we have 67 U; a partial outbreak protects 14, leaving a balance of 53 U. Add 40 more for the two years 1872 and 1873, and U = 93. An epidemic protects $\frac{3}{7}$ of U (or 35), and leaves 58 U. To these would be added about 20 in 1874, and another 20 (*i.e.*, 20 per cent. of the entries for the year) in 1875, making a total of 98 unprotected boys, which equals $\frac{T}{3 \cdot 6}$. The epidemic occurs, protecting 47, or, as usual, about $\frac{3}{7}$ of U, and leaving 52 U. By the end of 1881 there were about 162 unprotected in the school of 500 boys $\left(\text{equal to nearly } \frac{T}{3}\right)$; the epidemic protects 58 $\left(\text{not quite } \frac{3}{7} \text{ of U, or } \frac{1}{7} \text{ of T}\right)$, leaving 104 U. Add 50 more unprotected for 1882 and 1883, and the total becomes 154 U, or nearly the critical $\frac{T}{3}$; and another epidemic protects 71 $\left(\text{a little over } \frac{3}{7} \text{ of U}\right)$,

leaving 83 U. Add 25 more for each of the next three years, 1884–85–86, and the total reaches 158 $\left(\text{or } \frac{T}{3}\right)$, when another epidemic protects 77 $\left(\text{rather more than } \frac{3}{7} \text{ of U}\right)$, and leaves 81 unprotected. During 1887–88–89 and 1890 (with a population and entrance-rate both temporarily lowered) a further addition of 60 raised the number of unprotected to 141 out of the total 398 boys then resident $\left(= \text{nearly } \frac{T}{2 \cdot 5}\right)$ when another epidemic occurred, attacking 60 boys, $= \frac{3}{7}$ of U, or 15·07 *per cent.* $\left(\frac{1}{6 \cdot 6}\right)$ of T.

Certain checks exist to the introduction of infection into a school, and some of these are of the greatest value and importance. These checks comprise :—

1. An efficient system of "Health Certificates."* Not only should the entrance certificate brought by each pupil to a school clearly indicate the several diseases from which he has already suffered, and his then existing state of health; but no pupil should be permitted to return to school after the holidays without bringing with him a certificate—signed by the parent or guardian—to the effect that he has not, for some specified period (say, three weeks at least) been exposed to infection. In the event of any pupil falling ill, or being exposed to infection during the holidays, notice should be at once given by the parents to the school authorities (*i.e.*, to the master or to the medical officer), who will, in reply, inform the parents of the course which they are to adopt, and at the same time furnish them with a form, to be signed by the parent and guardian and forwarded to the school the day before the pupil returns, to the effect that the several regulations laid down by the school have all been complied with. No pupil should ever be allowed to re-enter the school directly after such illness or exposure to infection; the pupil must proceed direct to the sanatorium (or infirmary) with his clothes, &c., where he (as well as the clothing) will be properly disinfected and examined by the medical officer before being passed into the school. "Disinfection at home" cannot be relied on, and the invariable and impartial application of such a rule is essential to any effective system of hygienic precaution against the introduction of disease. It has been already shown that an increase in the average age of pupils markedly lessens the liability to epidemic outbreaks.

Even when an epidemic has been started, there are certain regulations and conditions, the wise application of which can do much to impede its extension. First stands the immediate notification to the medical officer of every case of illness as it occurs: by this means some

* NOTE.—Typical certificate forms for use in these and similar cases are given in the "*Code of Rules for the Prevention of Infectious and Contagious Diseases in Schools*," issued by the Medical Officers of Schools Association. Third and revised edition. J. & A. Churchill, London.

diseases (*e.g.*, scarlatina, chicken-pox) may be actually prevented from extending any further; and in the case of others much less possible to "stamp out" (measles, *e.g.*), the rate of progress can be much delayed by the same action which secures immediate attention to individual cases as they are recognised. But cases of illness must not only be immediately and effectively isolated from the presumably healthy for so long as they remain infectious; patients, and their clothing, &c., must be properly disinfected before they are permitted to re-enter the school.

The attendance of day scholars acts, as has been seen, by affording opportunities for the more frequent introduction of infection, and for the consequent protection thus secured to those pupils who, in successive small batches, contract the diseases thus imported; the supply of susceptible material never, therefore, reaches a large proportion of the whole number of pupils; and its dilution by those already protected effects much in checking the progress of an epidemic disease already introduced.

The existence of separate masters' "houses" is also effective to this end; although the whole school constitutes a general community affording numerous opportunities for and channels of personal intercourse between its members, these "houses" are, to some extent, separate sub-communities; and their existence is found to have an appreciable effect in at least delaying the progress of an epidemic through the large schools in which the system obtains.

Most important of all, probably, in the case of large schools at all events, is the subdivision into two distinct establishments; of which one—the junior school—contains pupils *up to* the age of about 12 years; the older pupils being drafted into the senior school. Most children tend to get through the list of ordinary infectious ailments by the age of about 15, with the single exception of scarlatina, *vide* Table B; but if associated during the earlier years of life with a large number of other young children, the opportunities for securing protection are greatly increased, and such a child will generally have completed his "course of epidemic inoculation" before the age of 13 at all events. Under such circumstances the senior school will comprise pupils who are practically not susceptible to the ordinary epidemics of school life, with the exception of scarlatina, and as this is a disease whose outbreaks are, or should be, almost always capable of immediate check and rigid limitation in a school, it follows that the much more serious and important work of the senior pupils is safeguarded against the disturbing interruptions of recurrent epidemics.

A study of the statistics at my command indicates—in the case of large schools with an entrance age of about 13 years, at all events—some interesting facts regarding the mutual relationship between different epidemic diseases, and the influence which they exert on one another when prevailing concurrently in a school.

Reference to the entrance statistics given in Table A, shows a curious equality between the number of boys already protected by measles and by whooping cough respectively; and this accordance is more marked for the later period, 1879–1887, during which time we

may assume that the differentiation between measles on the one hand, and Rötheln and epidemic Roseola on the other, had become more general and precise. This near equality of the returns for pertussis and for measles is, however, striking for all periods; it is, moreover, very equably maintained, not only throughout each of the 24 years noted in this table, but for each term during and subsequent to that period—as is demonstrated in the subjoined table, which embodies the returns made in a series of terms taken quite at haphazard.

TABLE D.

Terminal Returns for Measles and Whooping Cough.

Total Boys entered.	Total already protected by Measles.	Total already protected by Whooping Cough.
51	40	36
37	29	23
43	30	32
31	25	20
10	9	10
35	29	29
23	19	16
25	20	13
30	23	22
62	50	46
37	25	25

I am inclined to think, therefore, that for school boys of this age (13—14 *circ.*) the entrance statistics of the one disease may serve as a useful check against those of the other; although epidemics of pertussis are relatively rare, and of but moderate dimensions when they do occur, amongst adolescents from about the age of puberty upwards.

Rötheln epidemics often precede or follow those of measles, but, as the two are *very* rarely coincident, adequate hospital accommodation provided for the latter disease will also serve for Rötheln. For, if Rötheln epidemics are apt to be more extensive than are those of measles, the period of convalescence is shorter, in the proportion of about two to three; so that, during an epidemic, beds are so much the sooner cleared and available for fresh Rötheln patients. Rötheln sometimes, but less commonly, follows in the wake of scarlatina; and during the progress of an epidemic it will sometimes be observed that Rötheln develops morphologically in two divergent directions; so that some cases come, on the one hand, more and more closely to resemble scarlatina, and, on the other, to approximate to ordinary measles. But there is also another malady, still frequently confounded with German measles, under a common title of "Epidemic Roseola," which is apt closely to resemble mild cases of measles; it is common about summer time, is highly infectious, and is usually a very trivial complaint, though a not infrequent cause of trouble to the school and of alarm to parents.

We still sometimes hear of a close connexion between outbreaks of scarlatina and of diphtheria; I believe the alleged relationship, so far as

it exists, to be accidental; greater precision in diagnosis has always led to more exact discrimination, and probably accounts, in no small degree, for the greater recorded prevalence of diphtheria during recent years.

Mumps is responsible for many and extensive epidemics before puberty. After the age of 14, or thereabouts, its incidence is much less regular, and—as a disease by itself—its epidemics are not often very large. But it would appear that if mumps occur coincidently with measles, and so early in a school term as to allow the disease "full scope," the number attacked may equal, or even exceed, that affected with measles; and a similar observation applies, though possibly with less force, to coincident epidemics of mumps and Rötheln. The fact that exhalation from the air passages is a mode of infection common to all three maladies may throw some light on this point.

Sir George Paget long since pointed out that a convalescent from typhoid fever is almost always susceptible to vaccination; that, in fact, the previously protective influence of this latter has been destroyed or neutralised by the more recent disease. This fact, seeing that youth is *par excellence* the period for enteric fever, may serve as an additional argument in favour of always performing re-vaccination at, or before, the termination of school life; for, during adolescence—the period of active tissue-change—the immunity conferred, at least temporarily, by the primary vaccination of infancy is apt to become exhausted in most cases; and at least 70 per cent. of the re-vaccinations performed at or towards the close of school life have proved, in my experience, successful. The returns given under the head of Variola, in Table A, showing a decrease of 0·5 per cent. during recent years, is another proof of the increasing improvement in national health and health-seeking already alluded to.

As regards the hospital accommodation which should be provided for adequately dealing with outbreaks of epidemic illness in a large boarding school such as I have here been mainly considering—one, that is, containing 300 boys or more, the age at entrance averaging 13 to 13½ years, and that of leaving school 18 years—and allowing for two or more diseases being epidemic at the same time, we may conclude as follows: Beds should be provided to the extent of 2 *per cent.* of the *total* number of pupils, for dealing with *scarlatina*; 5 per cent. for mumps (and whooping cough); 2 *per cent.* for chicken pox—which (though readily taken by young children) does not give rise to extensive epidemics in schools of higher age, because, like scarlatina, early cases are easily recognised, and can, therefore, be promptly isolated before the malady has attained its most infectious stage; 1 *per cent.*, say, for such a disease as diphtheria; and 10 *per cent.* for measles (and Rötheln). It is often contended that it is both useless and unnecessary to provide special hospital accommodation for the two maladies last named. Yet each commonly induces a certain amount of physical debility, and is apt to predispose to other maladies; they seriously dislocate the work of the school; and each represents, for the patients attacked, a loss of educational opportunities at a time of life when they are most valuable.

Thus, for example, an epidemic of measles affecting 70 boys involves, to them, a direct loss of at least 2,000 working days, and probably, by interference with the class work, not much less to their fellows. Baffling as measles is, the prompt and thorough isolation of each case as it arises at least limits the activity of so many foci of infection, and must, therefore, have an influence in curtailing the epidemic; moreover, it ensures to each patient that early and efficient treatment and continuous observation which constitute the best safeguard against the development of dangerous complications and troublesome sequelæ. Is it, then, anything short of criminal to do less than attempt, in every possible way, to separate the obviously infectious from the presumably healthy, and thus to secure for each class of those under our care the best advantages that we can command for them?

Under the average existing conditions, and seeing that the ratio of the unprotected for all diseases appears to be steadily and continuously rising, it would seem that hospital accommodation for infectious disease to the extent of 20 *per cent.* of the total number of pupils, is not excessive for the needs of a large boarding school prepared to do its duty to itself and to its pupils.

It is not requisite that the whole of this accommodation should be provided in a building constructed in the same permanent and substantial manner throughout; from one-half to one-third of the amount named may fairly be of a semi-temporary character, as *e.g.*, a semi-detached *annexe* built of wood or of corrugated iron with double walls; and this, during lesser outbreaks, would serve admirably as a play-room for convalescents. Further, the existence of what is known as the "house-system"* in such a school tends at least to *delay* the progress of an epidemic, and may be considered to lessen the amonut of sanatorium accommodation required by a number of beds equal to from 3 to 4 per cent. of the total pupils. Again, in the case of the attendance of a considerable proportion of day scholars, it may be taken that the amount of hospital accommodation required will be less than that needed if no day boys attended, by a number of beds equal to at least 2 per cent. of the total number of boarders in the school. Finally, whenever a large school is subdivided into a junior and a senior establishment, the latter is thereby greatly protected against the incidence of epidemic disease; and it is obvious that, if the senior and junior schools be conducted as distinct establishments, there will be a very great disproportion as regards the amount of sanatorium accommodation severally needed in the two cases. Separate accommodation should also be provided for servants: but, even in large schools, a total of two or three beds will suffice under this head. And it is essential to good results that the infectious hospital, or "sanatorium" buildings should include an efficient disinfecting apparatus (large enough to deal with a full-size mattress); and a laundry, in which infected clothing can be thoroughly dealt with quite apart from the ordinary washing of the school.

* The several "houses" being distinct and isolated buildings.

It will not have escaped observation that the statistics of school illness at present available in this country are but fragmentary and incomplete. This is greatly to be regretted, for I am sure both that a mine of information of the most valuable kind lies here, only waiting to be worked, and that the elaboration and publication of such information can only redound ultimately to the great advantage of the schools themselves. The matter is at present engaging the attention of the Medical Officers of Schools Association, which hopes soon to be in a position to provide every medical officer of a school with simple schedule forms, on which the more important facts in connexion with the illnesses occurring amongst the pupils may be conveniently recorded. It cannot be doubted that the collation and study of such reports, extending over a series of years, and dealing with thousands of children, will prove of immense value, if only from the one point of view of the study of epidemic illness amongst the young. And here it will not be out of place for me to acknowledge my own indebtedness to the governing body of the school with which I am especially connected. Some years since, when I was working at the school statistics of entrance and illness to see what they might teach, I asked whether any objection would be raised to my making public the facts at my command, should a suitable opportunity present itself for doing so. In reply, the council decided unanimously and without demur that, as the medical officer of the school, I was at liberty to make any use, public or private, of all such facts connected with the sickness, health, and other details of the school as came within my official purview—provided only that their publication seemed calculated for the benefit of the school itself *or* of the public at large. It has, indeed, been contended, and perhaps rightly so, that no school is entitled to the selfish monopoly of the scientific truths which its existence reveals; but not every corporate body is so prompt to see, and so ready to do its duty in such matters; and the votaries of Hygiene, at all events, will be the last to withhold their approval of a course which is consonant with their teaching and in furtherance of their own endeavours.

Handwriting in relation to Hygiene.

BY

J. JACKSON.

I think it was Lord Palmerston who once remarked that "Writing "is almost as important as speaking, because every man, whatever his "station in life may be, must have constant occasion to convey his "thoughts, his wishes, his complaints, his desires, in writing; and "unless that writing be legible and easily read, with the letters well "formed, so that a person can read that writing without trouble and "delay, it fails by disgusting the person to whom it is addressed."

It does not, however, require the authority of a renowned and eloquent statesman to inform or to assure us of the ever-increasing employment and importance of the caligraphic art. There is no occupation or rank in life into which as a potent factor, as an energising influence, writing does not enter. Whether in the diary and correspondence of the private individual, the recording of the business transactions of the merchant, the literature of the author and scientist, the briefs of the barrister, or the manuscripts of the theologian and ecclesiastic, writing is alike everywhere paramount and universally potential.

But not only is it thus all pervasive in every-day life throughout the civilized world, it rises to even greater prominence and significance in the case of the hundreds of thousands who as secretaries, copyists, or clerks, follow writing as their profession or business, and derive from it their sole means of subsistence. Such individuals are employed the year round for from 8 to 16 hours daily exclusively in clerical work. It is indeed impossible to exaggerate the importance of an art which is pre-eminently a vital principle in the machinery of the Law, the Civil Service, Commerce, Science, and in individual as well as International communication.

If we inquire into the origin and development of handwriting, we find it had its birth in an age of semi-barbarism; that at first it consisted of the most inadequate because the most imperfect pictorial representations, which gradually merged into a very crude hieroglyphic as the basis of an incipient alphabet. Subsequently this was modified still further, until ultimately it developed into an equally crude phonetic, the characters in which had little if any scientific meaning or relationship. From the ornate and laboured style of the mediæval period our present Italian style has been evolved, and if we carefully trace this development through its manifold stages and variations, we shall discover that it and they have all been purely responsive to exclusively caligraphic or so-called artistic demands. Pursuing our investigation a step further, the fact is revealed that these caligraphic and artistic demands have been controlled and dictated, not by logical and scientific principles, but by capricious and often conflicting theories.

The writing and not the writer has invariably been the supreme consideration in the growth and perfecting of the art of penmanship. Such and such a style of writing was pronounced to be essential, the correct thing in short; the dictum was accepted, the idea of an appeal was never entertained, and our victimised ancestry were doomed to bow, cringe, and twist under the system of bondage thus established. As to Hygienic principles, these have never been associated, even in a remote degree, with the history of slanting writing, which up to quite recent years has reigned unrivalled and undisturbed in our midst.

Indeed physiological requirements have not been recognised, much less urged, at any rate not in England, until within the past few years; and even at the present day not one teacher in fifty would spontaneously admit any possible connexion between Hygiene and handwriting, so defective is the state of education in this matter. That these hygienic principles and physiological requirements are or should be an integral

part of any system of penmanship that is accepted by the nation, there cannot be a shadow of doubt; but we may repeat emphatically that the existing style of oblique or slant writing has been evolved and elaborated independently and in spite of every hygienic and physiological principle. It is not the less remarkable that when the subject of school postures first engaged the attention of the medical faculty, the real root of the malady was never for one moment suspected, and that for so long a time it remained undiscovered. Possibly this was after all not unnatural, as the conception of an imperfection in the writing itself would be the last to strike the mind of the inquirer. Hence the various and contradictory conclusions that have been made. First, we were informed the instruction was at fault. Teachers were indifferent, or not sufficiently careful to inculcate correct postures; it only needed strict attention, efficient supervision, and constant care to remedy the evil. Time and experience proved the contrary, and then came the crusade against desks and seats. The former were too sloping or not sloping enough, the latter were too high or too low, and they were not adjustable, so we got both sliding seats and sliding desks; but, unfortunately, the malady remained although the old desks had gone. The question of "light" next exercised the scrutiny of our experts, and bad light or unsuitable light was made the scapegoat. This theory was almost immediately exploded, and the question being still unsolved remained in abeyance for a brief space.

It is matter for sincere congratulation that subsequent research has proved more successful, that all external and subordinate points have been finally disposed of, and that the "system of writing—of *sloping* writing" is the sole subject of investigation. And we are highly gratified to learn that the consensus of opinion finds its expression in the almost unanimous declaration that the "slant" or "slope" of the writing is the undoubted cause of the unhealthy and abnormal postures so grievously complained of. For thirty years we have had abundant opportunity for observation and experiment, and we have no hesitation in giving an emphatic confirmation to the medical testimony just alluded to. No matter what pattern desks and seats are in use, or what the light may be, or what the nature of the instruction, whenever the children are required to write in the sloping style their postures will present every possible variety of distortion and abnormity.

I am glad to be able to quote from an article in the weekly Austrian Hygiene, edited by Dr. J. Daimer, Secretary of the Supreme Council of Health in Vienna, a reprint of which was kindly sent me by Professor A. Reuss, after this paper had been forwarded to the secretary, and translated by my friend Dr. Carruthers: "The question of school "benches was considered as solved by a correct proportioning to the "size of the body by the introduction of the minus distance, and the "application of so-called back seats. The question proved unsolved. "Children sat upon the new benches approved by the faculty *just as* "*badly as upon the old.*"

The concurrent evidence of a combination of medical experts and specialists from which there can be no appeal, warrants the assertion

i p. 2124.

that the side position of the body is inevitable in sloping writing; that twisting of the neck is equally unavoidable; that distortion of the spine must accompany the side position; that displacement of the right shoulder is a necessary consequence of the arm being pressed close in to the side; that the wrist must be deflected from the natural direction in order to maintain the required slope of the pen; that the side position of the body involves a disturbance of the common action of the two eyes, and that the oblique view thus obtained is more or less delusive; and that sprawling on or over the desks causing pressure on the chest is induced if not also required by the general posture imposed by the slanting writing. We will epitomise the directions given in our own young days, and still prevalent amongst the present generation of teachers, to a writing class:—1. Turn your left side to the desk. 2. Press the left arm close in to the side. 3. Place your left hand on the copy-book. 4. Press your right elbow in to the side. 5. Point your pen towards your right ear. 6. Turn your face towards the book. 7. Grasp the pen firmly and go on writing.

One involuntarily exclaims, What can be expected from a mode of writing that inflicts such conditions, such contortions as these? The reply is: From the writing, our expectations end in disappointment and acknowledged failure, since not twenty out of a hundred specimens of penmanship promiscuously taken are fit to be classed as excellent; and from the ranks of the writers, we obtain a vast number of debilitated and deformed victims so seriously afflicted in heart, lungs, spine, or eyes as to create a feeling of apprehension and alarm in medical and educational circles; yea, even in councils and cabinets. Eminent medical gentlemen have pursued their investigations into the question of postures with praiseworthy ability and exemplary patience. Whilst teachers have been, as a class, wholly quiescent, such men as Barnard, Cohn, Coindet, Carter, Guillaume, Leibrich, Carpenter, Von Reuss, Lorenz, Smith, and a host of others, have been indefatigably working with the outcome of a unanimous pronouncement that all the ills which initiated the inquiry are traced to the postures assumed in and required by the "slanting writing" taught in our schools. One writer tells us that "The postures of young people assumed in the sloping writing are "one of the chief factors in the production of spinal curvature." A second authority declares these posture to be "without doubt recog-"nisable as one of the most frequent causes of crooked growth."

Were this the only effect it would be more than sufficient to justify a thorough investigation into the whole question; but when equally dismal testimony is borne to the injury of other organs and the interference with other functions, the urgency of the case becomes vital and irresistible. I am not acquainted with any work that so fully exhausts this part of our question as the Reports of Drs. Reuss and Lorenz, already alluded to.

The great specific for these abnormal postures, with their train of disastrous consequences, is "vertical writing." The material difference between this upright or perpendicular style and slanting writing is in the direction of the down strokes of the letters: in the former being

definitely and absolutely upright, in the latter indefinitely and variously sloped or oblique. The difference which this slight and seemingly insignificant alteration in the down strokes makes, the effect which it exerts upon the writer is incredible, and when in conjunction with the minor characteristics of the system, viz., shorter loops, minimum thickness and continuity, the results are almost magical. Before detailing the several hygienic merits of upright penmanship, I would make grateful reference to some of the professional statements of medical men in favour of vertical writing. I say grateful reference, for to a teacher who has written the style and advocated its manifold claims to superiority for so many years, who has been met with derision and indifference, with incredulity and opposition, from almost overwhelming columns of prejudiced 'slopers'—it is more than solacing to receive the repeated, the unanimous, and the independent support of a phalanx of medical professors as invincible as it is incontestable. These experts (and in their own department they constitute our only qualified judges) declare that "vertical writing" is the only system consistent with all hygienic principles, that "It is impossible for writers to avoid twisting the spine "unless they adopt an upright style of caligraphy," that "The absolute "superiority of this method of writing over other methods must be "recognised," and that "Upright writing is very much to be preferred "to oblique writing."

Now, what are the postures or what is the position prescribed in the vertical writing? In one word, it is the natural position, the most normal position possible; indeed it is the posture that a pupil will instinctively assume, the attitude that he will naturally adopt in the effort to write vertically. Granted that the book lies evenly on the desk, and that the scholar has been duly instructed how to hold his pen between the thumb and two forefingers, the writer's position is dictated by the style of writing adopted, and he sits evenly and straight before his desk, with both arms thrown freely thereon, the whole posture being the simplest and easiest that could be prescribed for the efficient performance of the work to be done. The eye looks straight down upon its task, the hand, wrist, and arm are in the best posture for a running handwriting, the body is not distressed by artificial posing, the spine rests in a perfectly normal condition, the chest remains unrestrained by any undue leaning forward, and the writing is produced under the most favourable hygienic conditions with the least expenditure of energy, and therefore with the minimum amount of weariness.

Instead of the oblique position, we have the square or front posture; instead of the head all awry, we have a straight pose, securing an identity or parallelism of the facial and chest planes; instead of the elbows close in to the side, we have them both unrestricted and free; in place of the oblique and consequently delusive view of the book, we secure an even and perfect command of the writing; and instead of the awkward sprawl over the desk, we have the nearly upright position, free from even the tendency towards an unhealthy or painful attitude. It may be safely predicated that since all unnatural positions are precluded from the system, and that only the most natural and easy postures are

demanded by it, vertical writing in this relation may be accepted as strictly fulfilling every hygienic requirement.

Moreover, from an educational point of view vertical writing asserts its hygienic superiority, if we contemplate its simplicity and the resulting diminution of labour in teaching and acquiring the art. This economy I have frequently demonstrated as amounting to from 30 to 40 per cent. as a minimum. Also when we take into account the advantages it offers us in legibility and in speed (in both of which respects it is far ahead of sloping writing), thus securing an immense saving of time and energy in its production and perusal, we are driven to the conclusion that upright penmanship is the true penmanship, the *Ultima Thule* of caligraphic ambition, giving us the maximum of hygienic merits with no detracting disadvantages.

A word as to the actual achievements of vertical writing recorded in the evidence of numerous teachers in all grades of schools where it has superseded the old Italian style. And, after all, this test of experience is the crucial test which will once for all, and which has once for all, determined the correctness and soundness of theoretical medical experiments and deductions, and of our own educational categorical statements.

We are enabled to say that the *evidence is one*, undisturbed by a single conflicting dissentient. Scores and hundreds of contributions of this kind have been received, yielding a magnificent variety of testimony bearing on every possible question in the controversy. Briefly summarised, the evidence goes to show that wherever the Vertical Writing has been introduced it—(*a*) enkindles a greater interest in the art, both with teachers and children; (*b*) it entails much less labour in teaching; (*c*) it wonderfully accelerates the rate of progress and improvement; (*d*) it attains to a much higher standard of excellence, and develops a much greater command over the pen; (*e*) it materially increases the speed of the writer; and (*f*) lastly, it disposes finally and satisfactorily of the awkward and painful postures that have, under the *régime* of Sloping Writing, created such havoc in, and worked such irreparable mischief to, the juvenile constituency for so many years. Encouraged by these unquestionable facts, by the harmony and concurrence of both medical and educational evidence, and the more than commensurate results which have attended its introduction and adoption, one can surely be justified in believing that the day is not far distant when upright penmanship shall have the pre-eminence, and when (the relation and inseparable connexion of hygiene and vertical writing being universally recognised) it shall not need the protest of a faculty or the dictum of a council to make our people a nation of vertical writers, but all shall write vertically from the least even to the greatest.

It is, therefore, with the most profound and unqualified pleasure that I am thus enabled to submit to this Congress the practical and combined and unanimous experience of hundreds of teachers in support of the finding which so many distinguished members of the medical profession in this and other countries have arrived at as the result of

their independent and scientific investigations, and that I move the following *Resolution :—*

> "That as the hygienic advantages of vertical writing have been clearly demonstrated and established, both by medical investigation and practical experiment, and also that by its adoption the injurious postures so productive of spinal curvature and short-sight are entirely avoided, it is recommended that upright penmanship be introduced and generally taught in our elementary and secondary schools."

Demonstrationen die Einführung der Steilschrift in die Schulen betreffend.

VON

Dr. med. et phil. L. KOTELMANN, Augenarzt in Hamburg.

Unter den Fragen, welche augenblicklich die Schulhygiene bewegen, dürfte eine der wichtigsten, wenn nicht die wichtigste, diejenige nach der Einführung der Steilschrift in die Schulen sein. Denn es lässt sich nicht leugnen: soviel rationeller auch die neueren Schulbänke als die älteren sind und soviel auch fortgesetzt für die Verbesserung derselben geschieht, die Haltung der Kinder beim Schreiben lässt dennoch zu wünschen übrig. Es muss daher noch irgend ein Faktor nachteilig auf dieselbe einwirken, und als diesen Faktor sieht man mit Recht die in den meisten Schulen übliche Schrägschrift an.

Die letztere ist erst eine Erfindung der Neuzeit. Während des Altertums und des ganzen Mittelalters wurde steil geschrieben.

Ein altägyptischer Brief aus der Ramseszeit (14. Jahrh. v. Chr.), von dem Sie hier ein Faksimile sehen, weist Steilschrift auf. Dasselbe gilt von den älteren semitischen Schriftarten auf phönicischen, althebräischen, aramäisch-ägyptischen, palmyrenischen Inschriften, Münzen und Gemmen. Auch die griechischen und lateinischen Schriften, mögen sie nun auf Stein, auf Wachs, auf Papyrus oder einem anderen Stoffe geschrieben sein, zeigen Steilschriftcharakter.

Dass dieser auch während des Mittelalters beibehalten wurde, beweisen Schriftstücke aus dem 8. bis 16. Jahrhundert, welche von Dr. *Schubert* aus der Sammlung des germanischen Museums in Nürnberg veröffentlicht sind. Aehnliche Beispiele von Steilschrift finden sich in dem grossen Prachtwerke: "The Illuminated Books of the "Middle Ages. A history of illuminated books from the IVth to the "XVIIth century, by *Henry Noel Humphreys*, London, 1844," sowie in *Sickels* herrlichem Buche: "Monumenta graphica medii ævi," das aus Photographien von Urkunden auf einzelnen Kartons besteht. Von bekannteren Persönlichkeiten des Mittelalters schrieben, wie Sie hier sehen, steil: die Mitglieder der Nürnberger Patrizierfamilie *Pankraz* (1498) und *Brigitta Holzschuher* (1509), *Albrecht Dürer* (1506),

Michel Angelo (1510), *Leonardo da Vinci* (1517), *Luther* (1520), der Nürnberger Kaufherr *Paulus Behaim* (1533), sowie 83 Jahre später der Entdecker des Blutkreislaufes *Harvey* (1616).

Erst um die Reformationszeit findet die Schrägschrift Eingang, offenbar weil jetzt mehr und deshalb schneller geschrieben wurde. So zeigt die Handschrift *Isaac Newtons* (1682) aus dem britischen Museum Schrägschriftcharakter. Als Beispiel von Schrägschrift aus dem folgenden Jahrhundert lege ich die Photographie eines Briefes von *Mozart* (1777) vor. Die unter 45° geneigte Schrift wurde in Deutschland 1809 von dem Kalligraphen *Heinrigs* in Crefeld eingeführt. So wird denn Steilschrift heutzutage nur noch ausnahmsweise geschrieben, z. B. nach dem Vorgange seines Grossvaters und Vaters von dem deutschen Kaiser, von dem früheren preussischen Kultusminister *Falk*, von den deutschen Dichtern *Felix Dahn*, *Gustav Freitag*, *Hans Hopfen* und *Karl Frenzel.*

Und doch sollte dieselbe in Schule und Haus, namentlich in ersterer, die einzig übliche sein. Denn nur sie verbürgt eine richtige, die Wirbelsäule und das Auge nicht gefährdende Körperhaltung des Kindes. Die Steilschrift ist nämlich nur möglich, wenn das Heft, wie Sie an diesen Abbildungen mittelalterlicher Schreiber sehen, genau vor die Mitte des Körpers und zwar so gelegt wird, dass der obere Rand desselben parallel mit dem Tischrand verläuft. Da nun nach dem *Wundt-Lamanskyschen* Gesetze die Verbindungslinie beider Augenmittelpunkte, die sogenannte Basallinie, sich am liebsten parallel mit der Zeile stellt, so folgt, dass nur bei der eben erwähnten "graden Mittenlage" des Heftes der Kopf aufrecht, d. h. ohne Abweichung nach rechts oder links hin, gehalten wird. Liegt das Heft dagegen schräg vor dem Schreibenden in "schiefer Mittenlage," so wird der Kopf nach links hinübergeneigt, um die Basallinie in parallele Richtung mit den von links unten nach rechts oben verlaufenden Zeilen zu bringen. Damit aber nähert sich nicht nur das linke Auge der Schrift mehr, als wünschenswert ist, sondern es wird auch die Wirbelsäule nach rechts ausgebogen, so dass leicht Myopie und Skoliose entstehen.

Noch verwerflicher aber als die "schiefe Mittenlage" ist die "grade" oder "schiefe Rechtslage" des Heftes, bei der gleichfalls nur schräg geschrieben werden kann. Bei allen Rechtslagen nämlich werden Kopf und Rumpf nach rechts hin gedreht und das rechte Auge der Schrift mehr genähert als das linke. Aus diesem Grunde pflegt, wie durch eine umfassende Statistik von Dr. *Schubert* nachgewiesen ist, bei verschiedener Brechkraft beider Augen auch das rechte das stärker brechende zu sein. Eben wegen dieser von allen Hygienikern anerkannten Nachteile einer jeden Rechtslage des Heftes ist dieselbe denn auch in Bayern für Schulen verboten. In Preussen dagegen wird sie, wenn wir recht berichtet sind, in Lehrerseminaren und Schulen noch vielfach gelehrt.

Wie korrekt die Haltung eines steil schreibenden Kindes ist, ersehen Sie aus der Photographie, welche ich Ihnen hier zeige. Allerdings vermag auch das schräg schreibende Kind eine Zeit lang

aufrecht zu sitzen, wofür als Beleg diese Photographie eines russischen Gymnasiasten dient. Aber meist schon nach wenigen Minuten wird die richtige Haltung bei Schrägschrift aufgegeben, und die Kinder verfallen zum Teil in die wunderlichsten Stellungen. Am deutlichsten treten die Vorzüge der Steilschrift vor der Schrägschrift in Bezug auf Körperhaltung hervor, wenn man steil und schräg schreibende Kinder in naturgetreuen Abbildungen mit einander vergleicht. Aus der Schule des Herrn *Emanuel Bayr* in Wien ist berichtet worden und auch aus diesen Photographien ersichtlich, dass man sogar von hinten her steil und schräg schreibende Kinder an der Haltung unterscheiden kann. Einzig und allein kurzsichtige Schüler, welche keine Augengläser tragen, sitzen auch bei Steilschrift schlecht, d. h. vornübergebeugt. Diesem Uebelstande aber lässt sich leicht durch eine Brille für die Nähe abhelfen.

Neben den hygienischen hat die Steilschrift aber auch pädagogische Vorzüge. Schon der Umstand, dass die Kinder, welche noch keine ernsten Schreibversuche gemacht haben, ihre ersten Buchstaben steil zu schreiben pflegen, lässt vermuten, dass diese Schreibweise die natürlichere ist. Aus diesem Grunde wird sie auch leichter erlernt als die Schrägschrift und also Zeit und Arbeit bei ihrer Einführung erspart. Ein weiterer Grund für ihre leichtere Erlernung ist der, dass sie nicht wie die Schrägschrift an einen bestimmten schwer innezuhaltenden Neigungswinkel gebunden ist. So kommt es denn, dass sich nicht nur der Uebergang von der Schrägschrift zur Steilschrift ohne Mühe vollzieht, sondern dass auch Kinder, welche diesen Uebergang machen, ihre Handschrift nicht selten bedeutend verbessern. Liegt in dem Gesagten vor allem ein Vorteil für den Schüler, so hat auch der Lehrer einen solchen, indem ihm die Disciplin bei steil schreibenden Kindern keine Mühe macht; er braucht seine Kraft nicht auf fortgesetzte Ermahnungen zum Gradesitzen zu verschwenden, da die Steilschrift ganz von selbst zu richtiger Körperhaltung führt. Letzterer Punkt ist namentlich auch bei der Anfertigung der Hausaufgaben wichtig. Hat der Schüler diese in Steilschrift geschrieben, so ist man sicher, dass er die richtige Körperhaltung dabei eingenommen hat.

Unter diesen Umständen haben sich denn auch zahlreiche Mediziner und Pädagogen zu gunsten der senkrechten Schrift ausgesprochen. Aus medizinischen Kreisen ist in erster Linie das Gutachten des Obersten Sanitätsrates in Wien zu nennen. Dieser hat in seiner Sitzung vom 14. Februar d. J. einstimmig erklärt, er sei von der Zweckmässigkeit der Steilschrift überzeugt und deshalb an das k. k. Unterrichtsministerium das Ersuchen gerichtet, die geeigneten Schritte zur Einführung derselben in die Schulen zu thun.

Ebenso sind warme Anhänger der Steilschrift von den Anatomen Professor *Toldt* in Wien, von den Chirurgen Professor *Kocher* in Bern und Professor *Lorenz* in Wien, von den Ophthalmologen Professor *H. Cohn* in Breslau, Professor *Fuchs* und Professor *von Reuss* in Wien, von den Hygienikern Professor *von Fodor* in Budapest und Professor *Uffelmann* in Rostock, von den praktischen Aerzten Dr. *Wilhelm Mayer* in Fürth.

Was die Pädagogen anbetrifft, so ist namentlich der Schulleiter und Lehrer der Kalligraphie *Emanuel Bayr* in Wien für die Verbreitung der Steilschrift in Unterrichtsanstalten unermüdlich thätig gewesen. Ebenso haben sämmtliche Wiener Bezirkslehrerkonferenzen mit einziger Ausnahme derjenigen des X. Bezirkes, wo nur eine sehr geringe Majorität dagegen war, für die Einführung der Steilschrift in die Schulen gestimmt. Auch der Lübecker Lehrerverein hat in seiner Sitzung vom 15. Mai d. J. nach einem diesbezüglichen Vortrage des Lehrers *G. Hoffmann* erklärt, dass die senkrechte Schrift die geeignetste Schulschrift sei. Endlich unterbreite ich Ihnen hier eine grosse Anzahl Urteile von Lehrern aus Deutschland, Oesterreich und der Schweiz, welche bei verschiedener Motivierung alle darin einig sind, dass bei Schulkindern die Steilschrift an die Stelle der Schrägschrift treten muss. Da diese Urteile in Steilschrift geschrieben sind, so geben sie zugleich ein Bild von der grossen Deutlichkeit, Leserlichkeit und Schönheit derselben.

Dass sich die Sache auch praktisch durchführen lässt, dafür dienen diese Steilschriftproben von Schülern und Schülerinnen in Nürnberg, Fürth, Schwabach, München, Berlin, Hannover, Flensburg, Leipzig, ferner in Wien, Währing bei Wien und Prag, sowie in Winterthur und Eschlikon in der Schweiz zum Beweis. Unter diesen Proben befinden sich sowohl solche von Kindern, welche von Anfang an Steilschrift geschrieben haben, als auch solche, bei denen die Steilschrift an Stelle der früher geübten Schrägschrift getreten ist. Die höhere Schule für Mädchen in Leipzig hat die Eigentümlichkeit, dass sie beim Schönschreibunterrichte in Steilschrift, alle sonstigen schriftlichen Arbeiten aber in Schrägschrift schreiben lässt, eine Einrichtung, die uns wenig empfehlenswert scheint. Natürlich sind die Steilschriftproben derjenigen Kinder die schönsten, welche wie die von Fürth, Berlin und Flensburg schon mehrere Jahre steil geschrieben haben. Ein entschiedener Mangel war es, dass wir bis vor einiger Zeit keine Vorlagen für Steilschrift besassen. Diesem Mangel ist jetzt durch die treffliche "Schreibschule" von *Scharff* und durch *J. Kauffs* "Die gerade Schrift bei gerader Körperhaltung" abgeholfen. Ein weiterer Fortschritt für die praktische Durchführung der Steilschrift in Schulen ist der, dass man kürzlich in Nürnberg besondere Schreibhefte für dieselbe herausgegeben hat. Da nämlich auch bei grader Mittenlage des Heftes die rechte Hälfte desselben sich, genau genommen, in Rechtslage befindet, so hat man letztere dadurch zu verringern gesucht, dass man besonders schmale Schreibhefte für Steilschrift anfertigen liess.

Zum Schlusse lege ich Ihnen noch die in Deutschland bisher erschienene Litteratur über Heftlage und Schriftrichtung vor, welche, wie Sie sehen, bereits 3 stattliche Bände umfasst. Zahlreiche Männer haben sich um diesen Gegenstand verdient gemacht. Ich führe nur *Weber*, *Cohn*, *Berlin*, *Rembold*, *W. Mayer*, *Schenk*, *Kocher*, *Ellinger*, *Gross*, *Staffel*, *Bayr* und *Daiber* an. Das Verdienst aber, die Vorzüge der Steilschrift vor der Schrägschrift theoretisch und praktisch am sichersten begründet zu haben, gebührt dem Nürnberger Augenarzte

Dr. *Paul Schubert*, dem ich auch einen grossen Teil des hier demonstrierten Materiales verdanke. Aus dem gleichen Grunde bin ich Herrn Professor *H. Cohn* in Breslau für die Ueberlassung von Photographien mittelalterlicher Handschriften aus dem britischen Museum verpflichtet.

DISCUSSION.

Mr. Noble Smith supported the resolution moved by Mr. Jackson. His attention was first called to the subject when he made an inquiry for the School Board for London some years ago. His observations referred to the seats and desks, but he found that the School Board schools were better supplied with seats and desks than ordinary schools. He thought the subject well worth attention, and he further advocated the use of a pencil rather than pen and ink for school exercises. He moved as an *Amendment* "to omit the word 'entirely' and substitute the words 'to a great extent.'" The amendment was seconded by Dr. Gladstone, opposed by Mr. C. E. Keevil and Dr. Hutton, and then carried. The motion, as amended, was carried, with one dissentient.

American Child-Labour Laws.

BY

A. Jacobi, M.D., New York.

What I have to offer to-day is but a summary of facts and dates It is good principle and practice to look about now and then, and view the progress made in any human sphere; not so much for the purpose of enjoying the sense of having accomplished much, as to behold the height you have to climb, so far above you.

A hundred years ago there was no law regulating the relation of the working people to their employers at all. Seventy-five years ago, and later, babies of three and four years had to work in mines as a matter of course, and died; little children were employed in sweeping chimneys, and died; the pauper quarters and poor houses were emptied of their babies and children, who thus proved the cheapest raw material that could be used in the interest of greedy industry. England, being almost the only country in which the industrial and manufacturing interests flourished, was the principal theatre of these abominations. But, having committed the first and greatest sins, she was the first to retrace her steps and legislate in the interest of the helpless creatures. Now, tentative and empirical as all the legislation has been both in England and other countries, it still has accomplished very much. Restrictions have gradually been found necessary and possible in regard to the ages of children to be employed, the number of working hours,

the time of the day, the months of the year, and the character of the work; and in many parts of the world an educational test is applied. All these are as praiseworthy as they have proved successful. But the tentative and empirical nature of all such legislation is perhaps shown by nothing better than by the fact that the agricultural labours of the very young have never been included in any of the many acts provided for the protection of childhood.

Legislation for the purpose of confining child-labour within certain limits will be found parallel with the advancement of human and social culture in general. But to look upon the labouring children with merely a sympathetic eye, and a warm heart, does not cover the case at all. The question can be approached both with a sympathetic warm heart and from a calculating business point of view. In America, the legislative interference with the old way of brutally abusing children was first launched against the manufacturers to protect the young against the physical dangers resulting from premature and protracted work, confinement, bad air, and its consequences; also deformities, losses of limbs and lives. But the study of the discussions of legislative bodies and of the numerous annual reports of factory inspectors of a dozen States of the Union and provinces of the Canadian Dominion, for the furnishing of which I am under the greatest obligations to these gentlemen, has taught me that the laws enacted, one by one, with progressive improvements in their tendencies and results, were less the results of warm-hearted impression, than of clear-sighted statesmanship. Early child labour interferes with schooling and education. Child labour means ignorance, ignorance means helplessness and poverty, poverty means, or may mean, and does mean in a hundred thousand cases, shiftlessness and poorhouse, crime and prison. Thus human society protects itself, the State secures itself, by setting its face against premature child-labour. The dwarfed physical condition may people the hospitals and degenerate the physical state of coming generations—a great misfortune. But, what is more, the results of ignorance and the mental degeneration depending thereon will destroy the life of any nation. We in America are in great danger. In their first report the factory inspectors of the State of New York (1887), make the statement that American-born children were less educated than many foreign-born, to such an extent that many did not know even the name of the State they lived in.

This looks almost impossible with our American public school system. But it must not be forgotten that the children of the most forlorn and ignorant immigrants are called American-born, and are very numerous; and many of those children who themselves come from foreign parts, Germany for instance, have profited by the system of compulsory education prevailing in their former countries. Now, the very lowest politician amongst us has an interest in the stability of the republic; the good citizen and the statesman look upon the permanence and perfection of its institutions as the safeguard of its own future, and as an example for, and the future of, mankind. What if the generations of America get drowned in ignorance? Our dangers at this very time are very great. We have to digest and amalgamate the seven millions of negros, and as

many more illiterate foreigners who found a haven on our shores, and helped to develop onward their material resources. But while so doing the tornado of the immigration of the scum of Europe, the sunny south, the far south-east, the mediæval east, is sweeping over our land. Our country gives them citizenship within five years; many of us are afraid lest the conservative high-mindedness of the united republics will cause the victory of ignorant and uncouth hordes over an established civilization. Education is the only safeguard, but education requires time, and time that must not be spent in manufacturing establishments. Early child-labour interferes with child-education. That is why most American States have tried to defer the age at which labour in manufacturing establishments is permitted; that is why they insist upon compulsory schooling.

The Commission of the British Parliament appointed in 1875 to consolidate former Acts (those of June 22, 1802, of July 1819, of January 1833, of 1864, 1867, 1874, and many others) reported in February 1876. Its work resulted in "The Factory and Workshop Act, 1878." English legislation was imitated by Austria-Hungary in 1859, France in 1874, Switzerland in 1877, Germany in 1878. Of the English possessions the Presidency of Bombay enacted laws regulating factories and workshops up to 1882, the province of Ontario in 1884, and that of Quebec in 1885. Some of the United States took the matter up soon after the British Consolidation Act; New Hampshire in 1879, Maine, Rhode Island, Vermont, and Maryland in 1880, Massachusetts in 1882, New Jersey in 1883, Ohio in 1884, New York in 1886, Connecticut and Wisconsin in 1887, and Pennsylvania in 1889. It will be noticed that no southern States are mentioned; but it must not be forgotten that these States, particularly Georgia and Alabama, are just entering upon their period of participating in the methods of industry and commerce of modern civilization. The same may be said of many northern, or rather western States.

The "Second Biennial Report of the Bureau of Labour Statistics of the State of *Minnesota*, 1889–1890," by John Lamb, Commissioner, contains much valuable material. Unfortunately, the State of Minnesota has no laws prohibiting or regulating child-labour.* It is true, however, as I stated before, that the system of employing children in factories has not become so prevalent in Minnesota as in many of the eastern, southern, and central States. Less than half a dozen establishments are distinctively operated by child's labour. Nothing short of a census inquiry can reach the bulk of the children employed, for they are scattered and isolated. Still, the great manufacturing and mechanical industries of this State are not of the class wherein child labour can be, to any extent, profitably employed.

The legislation of the State of *Wisconsin* is about as defective as that of Minnesota, and for the same reason. Only Section IV. referring

* Personal letter from Mr. L. G. Powers, Commissioner: "Minnesota has no "laws relating to child's labour; hence there is no attempt made to place any "restriction upon it."

to the "Powers and duties of the Bureau of Labour and Industrial Statistics," speaks of the duty of the Commissioner to examine . . . . . "The employment of illegal child labour, the exaction of unlawful hours of labour from women and children." . . . . . .

But factory legislation referring to children does not always depend on external and material conditions, but sometimes on the state of public conscience and social culture, which are not always identical even in the older commonwealths, and perhaps even sometimes on mere thoughtless conservatism. Consequently, the regulations and stipulations differ very much in different communities; many resemble the British, many are more advanced, and many lag behind.

Thus, for instance, Mr. James R. Brown, Inspector of the Central District of the Province of *Ontario*, Canada, finds fault (1890) with the legislation in force, and referring to the State of Ohio, where nobody less than 16 years old is allowed to engage in hazardous occupations, insists that 14 years should be declared the minimum age for such employment. Mr. O. A. Roque, of the Eastern District, proposes 16 years for the same purpose, and adds, in referring to another topic: "In my report of 1888, I stated that the inspectors would be consider-" ably assisted in preventing the employment of young children in " factories by the putting in force of the school law, compelling them to " attend school, but up to this time I have observed that no such steps " have been taken in any locality in my district, except, perhaps, in the " city of Ottawa. I consider that this object could be more effectually " attained by an amendment to the Act preventing the employment " of children under 14 years of age in any saw-mills, and of children in " any factory covered by the Act under the age of 16, unless such " children are able to read and write, and a certificate to that effect " be furnished to the inspector whenever required."

From a paper read in New York by Inspector Barber, of the Province of *Toronto*, Canada, before the Fourth Annual Convention of Factory Inspectors, in August 1890, and from official documents kindly sent me by that gentleman, I present the following statements: The Ontario Factories Act, in force in the Province of Toronto, became law in 1884, but the inspectors, of whom there are three, were not appointed until late in June 1887. By the definition of a factory (including workshops) no place of employment comes within the jurisdiction of the Act unless there are at least six persons employed; originally the number was 21 persons.

No girl under 14 years of age, and no boy under 12 may be employed. Boys between 12 and 14 years of age must produce a certificate of age from a parent or guardian. This is to prove that such boy is actually of the alleged age. No certificate of age is required for girls, but the inspectors occasionally demand one when they are of opinion a girl is not 14 years old. The inspector also has the power to get the opinion of a physician as to a child's age, and such opinion overrules the statement of a certificate, if at variance with it.

The hours of work for boys under 14 years and females of any age are restricted to 60 a week and 10 a day; but the day's work may exceed

10 hours on condition that the number of hours so exceeded be taken off Saturday's working hours.

The Act in no way restricts the working hours of males 14 years old and upward, nor does it fix the time, day or night, for beginning or ceasing work. So long as 60 hours a week are not exceeded by females and children, they may work by day or by night, as the case may be.

The chief industries in Ontario that utilize the over-time clauses of the Act are confectionery, gloves, hosiery, knitted goods, shirts and collars, ladies' underwear, ivory buttons, fruit-canning factories, flannels, and blankets. The confectionery trade is pressed with orders in November and December. The trade in clothing and textile fabrics increases during the season. Fruit and vegetable canning factories frequently, when the hour for ceasing work approaches, have a quantity of fruit in process. So the law has given considerable latitude to these industries. For the latter industry there is no restriction as to the age of children employed, so long as their work is previous to the cooking process; after that process the general law applies in any case. Sixty hours are a week's work for all males and females under 14 years old, except under the over-time permit, when 12½ hours extra may be worked in five nights if it can be done by nine o'clock. Females 18 years old and upward may work later.

Here are plenty of loopholes for the carelessness of parents, and the greediness of trade.

The Province of *Quebec* adopted on December 30th, 1890,* the following:—

No male child aged less than 14 years, and no girl aged less than 15 years can be employed in a tobacco or cigar factory. In factories indicated in another list as unhealthy and dangerous, the age of the employed cannot be less than 16 years for boys and 18 years for girls.

In all factories other than those above mentioned, the age must not be less than 12 years for boys and 14 for girls.

There is no law that children and women must not work in the night. Under the law, however, the time between midnight of Saturday and midnight of Sunday must not be utilised. Indeed, alternate gangs have been kept at work in many instances.

There is no sort of compulsory education law, and no educational test like that of Great Britain. Therefore, one of the inspectors recommends half-time work for children, particularly as it has been found by experience that though there be evening schools, the overworked children cannot avail themselves of them.

In *New Hampshire*, no child under 10 to be employed by any manufacturing corporation. No child under 12, who has not attended the school of the district the whole time it was kept open. None under 14, unless he has attended school six months. None under 15, more than 10 hours per day without written consent of parent or guardian. None under 16, unless he has attended school for 12 weeks during the preceding year, and no child under said age shall be employed

* Not until then was there anything like a classification of dangerous trades.

(except in vacation time) who cannot write legibly and read fluently "in the readers of third grade."

The law of *Maryland* prohibits the employment of children under 16 years of age in factories for more than 10 hours per day, but has no limitation of age.

In *Rhode Island*, no child under 12 years of age can be employed in any manufacturing establishment. None between 12 and 15, more than 11 hours in any day, nor before 5 a.m., nor after 7.30 p.m. None under 15, unless he has attended school at least three months during the preceding year; and no such child shall be employed for more than nine months in any year.

In *Vermont*, children under 10 must not be employed at all; between 10 and 15, not in mill or factory unless they have received three month's schooling the preceding year; under 15, not more than 10 hours per day.

The Child Labour Law of the State of *Maine* prohibits the employment of minors under 12 years of age, and fixes 10 hours per day as the maximum length of time in which all children between the ages of 12 and 15 are permitted to work. The "Fourth Annual Report of "the Bureau of Industrial and Labour Statistics for the State of Maine, "1890," by Samuel W. Matthews, Commissioner, August, 1891, remarks that a number of large manufacturing establishments do not care to employ children between the ages of 12 and 15, for this reason: Under the present law the children between the ages above-named, are compelled to attend school for a part of the year, and owing to this fact, many establishments have substituted older help in place of these school children. It also complains that it is more the parents than the manufacturers who openly or stealthily oppose the law; and also that there is no uniform system as to the issuing of school certificates; and lastly, that there is no good compulsory education law. The law in Maine to compel the attendance of truant children is practically a dead letter, and has been so for years, excepting in one or two cities, where special officers are provided to enforce it. The manufacturer often complains that he sends the children out of his establishment to go to school, but instead of so doing they spend their time running about the streets. Therefore a law similar to the New Jersey Compulsory Education Law of 1885 is recommended.*

In the State of *New Jersey*, no boy under the age of 12 years, nor any girl under 14 years of age, shall be employed in any factory, workshop, mine, or establishment where the manufacture of any goods whatever is carried on, and no child between the ages of 12 and 15

---

* The New Jersey Compulsory Education Law of 1885 enacts "that in all cities "having a duly organised police force, it shall be the duty of the police authority, "at the request of the inspectors of factories and workshops, or of the school "authority, to detail one or more members of the said force to assist in the enforce-"ment of this Act and in districts having no regular police force, subject to this "Act, it shall be the duty of the Board of Education, or the school district officers "to designate one or more constables of said city, township, or village, whose duty "it shall be to assist in the enforcement of this Act, as occasion may require."

years shall be employed in any factory, workshop, mine, or establishment where the manufacture of any kind of goods whatever is carried on, unless such child shall have attended, within 12 months immediately preceding such employment, some public day or night school, or some well recognised private school; such attendance to be for five days or evenings every week during a period of at least 12 consecutive weeks, which may be divided into two terms of six consecutive weeks.

In *Massachusetts*, no child under 13 years of age shall be employed at any time in any factory, workshop, or mercantile establishment. No such child shall be employed in any indoor work, performed for wages or other compensation, to whomsoever payable, during the hours when the public schools of the city or town in which he resides are in session, or shall be employed in any manner during such hours unless during the year next preceding such employment he has attended school for at least 30 weeks as required by law.

No child under 14 years of age shall be employed in any manner before the hour of 6 o'clock in the morning or after the hour of 7 o'clock in the evening. No such child shall be employed in any factory, workshop, or mercantile establishment, except during the vacation of the public schools in the city or town where he resides.

No child under 16 years of age shall be employed in any factory, workshop, or mercantile establishment, unless the person or corporation employing him procures and keeps on file the certificate of his having obtained a common school education.

No child who has been continuously a resident of a city or town since reaching the age of 13 years shall be entitled to receive a certificate that he has reached the age of 14 unless or until he has attended school according to law in such city or town for at least 30 weeks since reaching the age of 13, unless such child can read at sight and write legibly simple sentences in the English language or is exempted by law from such attendance.

In reference to the condition of things in Massachusetts, I quote a few remarks from the report of the Chief of the Massachusetts District Police for the year ending December 31st, 1889. He states that the main objections and obstructions both in regard to education and to age come from the parents of the children to be employed, that the manufacturers have now and then discharged minors who have refused to visit evening schools. It is also complained that the law referring to compulsory education and school certificates is still ambiguous; but it is claimed that 80 per cent. of children between 10 and 14 formerly at work are now receiving an education; and that there are but few illiterate minors where evening schools are maintained. Particular stress is laid, and justly so, on chapter 348 of the Acts of 1888, section 2, which reads, "No child under 14 shall be employed in any manner before the hours of 6 a.m. or after 7 p.m.," and refers to theatres or other places of amusement.

But under the laws of *Ohio*, the employment of children under 12 years is only forbidden in manufacturing establishments, while other industries, for instance, the work in mercantile establishments, and hotels, and the messenger service, are entirely unrestricted. This is

certainly wrong, inasmuch as in many particulars this labour is as pernicious as the rest, both physically and morally. Besides much of the labour connected therewith has to be performed in the night, to the detriment of the general condition, and particularly of the eye-sight. Indeed, Section 6896 of the Revised Statutes of Ohio forbids the employment of children under 18 years for a longer period than 10 hours per day or 60 per week, but it matters not when this employment takes place, whether during the day or night. This compares unfavourably with New York and Massachusetts, both of which forbid the employment of children under 18 and of women after 9 p.m.

Still, on the 8th day of April, the general assembly of the State of Ohio passed an Act to prevent the engagement of children in such employment whereby their lives and limbs might be endangered, or their health injured, or their morals be likely to be impaired.

In order to secure uniform obedience to the law, the Chief Inspector of Workshops and Factories, Mr. William L. McDonald, distributed directions* in reference to very numerous "employments at which "children under the age of 16 years shall not be engaged."

In the State of *New York*, no child under 14 years of age can be lawfully employed at any time, or for any period, however short, in any manufacturing establishment.

No child under 16 shall be employed in any manufacturing establishment who cannot read and write simple sentences in the English language, excepting during the vacations of the public schools in the city or town where the child lives.

The name and age of every child under 16 years of age must be posted in the room wherein it is employed. A register must be kept of all children under 16 years of age employed in manufacturing establishments; in such registers must be recorded the name, birthplace, age, and place of residence of such children. This affidavit and the register must be produced on demand made by the factory inspector or any of his deputies.

To violate or omit to comply with any of the foregoing requirements is a misdemeanor punishable by a fine of from 20 to 100 dollars, or by an imprisonment of from 30 to 90 days, or by both fine and imprisonment. To swear falsely to any affidavit as to age, &c. is perjury, and punishable as such.

In *Connecticut*, no child under 13 years can be employed in mechanical, manufacturing, or mercantile establishments at any time. Children between 13 and 14 may be employed if they have attended school for 60 days within the preceding 12 months. Children under 13 and over 8 may be employed if they have attended school for 120 days within the previous school year, but not in a mechanical, manufacturing, or mercantile establishment.

In *Pennsylvania*, no child under 12 years of age shall be employed in any factory, manufacturing or mercantile establishment. No child

---

* Seventh Annual Report of the Department of Inspection of Workshops and Factories to the General Assembly of the State of Ohio for the year 1890. Columbus, 1891.

under 16 shall be employed, unless there be first provided an affidavit stating the age, date, and place of birth of said child. No minor under 16 shall be allowed to clean machinery while in motion. But no person, firm, or corporation, employing less than 10 persons who are women or children, shall be deemed a factory, manufacturing or mercantile establishment within the meaning of the law.

This latter clause is unfortunately found in the laws of a number of States. Thus it is, that under the authority of Society, any number of children may be employed and overworked. Besides, the agricultural work, the messenger service, and minor occupations about the houses, restaurants, &c. are not considered at all. The theatrical business is mentioned in the law of Massachusetts only. Thus the working of the laws, such as they are, leave much to be desired. Still, things are much improved compared with what they were before the enactment of those laws, and compare favourably with the condition of the factory children both in Great Britain and Canada.

How timely legislation in their favour really is, is best proven by the prevailing tendency to coerce them into factory service.

The Census Tables of the United States of 1870 and 1880 exhibit an increase of population of 30·23 per cent.; the increase in the number of those actually engaged in gainful occupations was much greater, and a disproportionate share of the increase falls in the class between 10 and 15 years of age. This class was represented in 1870 with 739,164; the ratio of increase of this class was 18·65 per cent., and would make the proportionate number 877,018. The actual number employed, however, was 1,118,356, with a relative excess of 241,338.

The object of child-labour laws is to prevent the child from being abused in the interest of production, and from being crippled in its normal development. The final evolution of mankind on the road to culture and humanity must necessarily include the full development of mental and physical forces of the growing individual, before the latter is compelled to participate in the labours requiring both. However, for the period of social progress at which we have now arrived, this view may appear utopian. But the very ideas regulating our present intercourse, and the mutual relations of capital and labour, would have appeared utopian centuries ago. So-called impossibilities have disappeared suddenly, when least expected. Mankind will sometimes adjust long continued grievances which appeared to be as firmly settled as the rocks, in sudden explosions. That solemn August night, a hundred years ago, which did away with feudal and class privileges and prejudices, and the outbreak of a civil war to wipe the spot of human slavery from the face of the United States, prove the possible proximity of the unexpected, and the perfectibility of the race.

Thus we have reason to hope that child-labour will be more and more limited, and finally disappear. No hard labour ought to be expected of the individual as long as he is not fully developed. Nor is it required. As early as 1876 the Royal Commission appointed in 1875, reported as follows: "We have no reason to believe that the "legislation which has been productive of such marked benefit to the "operatives employed, has caused any serious loss to the industries to

i p. 2124.

" which it has been applied. On the contrary, the progress of manu-
" facture has apparently been entirely unimpeded by the Factory Acts;
" and there are but few, even amongst the employers, who would now
" wish to repeal the main provisions of the Acts, or would deny the
" benefit which has resulted from them."

I do not care to discount the distant future, when those able to work will, by common consent, be compelled to contribute their share to the required production of material and intellectual goods, when the working power of millions of able-bodied men will no longer be spent on the gorgeous display of alleged preparations for war, and other millions will no longer waste time and opportunities on distributing goods by waiting for, and on, customers; and when the labour necessary for the accumulation of products will be no longer demanded from those who would serve society better by first developing their physical and intellectual powers. Therefore, for the time being, we have every reason to greet with satisfaction the wisdom of additional legislation, as suggested by the Committee on Resolutions, of the Fourth Annual Convention of the International Association of Inspectors of Factories and Workshops of North America held at New York City, August 27–30, 1890, in the following words:—" To prevent the employment of
" children in factories, workshops, and mercantile establishments under
" 14 years of age, and compelling all children of such age, and all
" unable to read and write intelligibly the English language under
" the age of 16 years, to attend some public or private school until so
" qualified. To prevent the employment of any child under 16 years
" of age in any hazardous occupation, or in which its health is liable
" to be impaired, or its morals corrupted, and the employment of any
" minor under 18 years of age, or of any woman later than 9 p.m. or
" earlier than 6 a.m. of any day, and that no minor under 18 years
" of age, or woman, shall be employed more than 60 hours in one
" week; and we recommend that all legislation for regulating the hours
" of labour, and the employment of women and minors, be made
" uniform in the several States, excepting in the Province of Quebec,
" where French is spoken generally, where the same degree of efficiency
" should be required in the French or English language, here repre-
" sented. That laws be enacted in all States and Provinces requiring
" that at least 250 cubic feet of air-space be provided for each person
" employed in workshops during the day-time, and 400 cubic feet
" during the night-time, and that adequate means for free ventilation
" be provided, and we deem it advisable that children in our public
" schools be taught the importance of the preservation of health in all
" conditions of life, and a knowledge of the laws of hygiene and
" sanitation."

(Signed) Evan U. Davis (O.).
L. T. Fell (N.J.).
Jos. M. Dyson (Mass.).
John Traney (N.Y.).
Robert Barber (Canada).
W. S. Simmons (Conn.).
Committee.

An objectionable Feature of some Burial Societies in their relation to Infant Life Insurance.

BY

CHARLES E. PAGET, M.R.C.S., D.P.H., Medical Officer of Health for the County Borough of Salford.

As medical officer of health for a large manufacturing borough, the regular occurrence within it of an excessive infant mortality has necessarily occupied much of my attention.

The mere fact that female labour is at a premium in a manufacturing town opens up at once many roads by which the questions relating to the possible causes of high infantile mortality may be approached. It is, moreover, very difficult to separate one special cause for such mortality from those more common and more easily recognisable causes which are known under the headings of hereditary predisposition, food, want of cleanliness of air, soil, and water, and seasonal diseases.

In the course of my inquiries, however, I was naturally led to consider the possible influence of infant insurance as a predisposing cause of infant mortality, and though I am unable to bring forward evidence of a decided character in this respect, yet there are certain circumstances in connexion with the conduct of some burial societies which it seems to me ought to be more widely recognised and considered in relation to the main question.

A high infant mortality is common in large towns, but it is usually greatly aggravated in large manufacturing towns; it is also in large towns that indiscriminate infant life insurance is under the least restriction. In the first place, there is more scope for the collectors of a society in a town than in a country district, and more chance of their making something of a living out of the collection of dues and the increase in membership. But, besides, in country districts there is too great a knowledge of one neighbour's affairs by another, and too many petty jealousies, for suspicious proceedings, even within a family circle, to be passed over without comment. In a larger community, on the other hand, there is a tendency towards a closer union, the consequence of a harder struggle for existence under unfavourable surroundings and arising also in respect of wage and other social matters; there may also possibly be a common sympathy over the difficulties and the troubles of infant rearing in large urban districts. Anyhow, it does appear as if there was a smaller sense of parental responsibility in towns than in country districts, and certainly when the mother is herself a wage-earner that is an adverse condition against which a weakly child has further to contend in its struggle for existence.

The temptation to make capital out of weakly infant lives must be, among some of the poorer classes in large towns, a far greater one than most people can estimate, for to them the immediate possession of a sum of money equal to or double a week's wages is probably more to the

" which it has been applied. On the contrary, the progress of manu-
" facture has apparently been entirely unimpeded by the Factory Acts;
" and there are but few, even amongst the employers, who would now
" wish to repeal the main provisions of the Acts, or would deny the
" benefit which has resulted from them."

I do not care to discount the distant future, when those able to work will, by common consent, be compelled to contribute their share to the required production of material and intellectual goods, when the working power of millions of able-bodied men will no longer be spent on the gorgeous display of alleged preparations for war, and other millions will no longer waste time and opportunities on distributing goods by waiting for, and on, customers; and when the labour necessary for the accumulation of products will be no longer demanded from those who would serve society better by first developing their physical and intellectual powers. Therefore, for the time being, we have every reason to greet with satisfaction the wisdom of additional legislation, as suggested by the Committee on Resolutions, of the Fourth Annual Convention of the International Association of Inspectors of Factories and Workshops of North America held at New York City, August 27–30, 1890, in the following words:—"To prevent the employment of
" children in factories, workshops, and mercantile establishments under
" 14 years of age, and compelling all children of such age, and all
" unable to read and write intelligibly the English language under
" the age of 16 years, to attend some public or private school until so
" qualified. To prevent the employment of any child under 16 years
" of age in any hazardous occupation, or in which its health is liable
" to be impaired, or its morals corrupted, and the employment of any
" minor under 18 years of age, or of any woman later than 9 p.m. or
" earlier than 6 a.m. of any day, and that no minor under 18 years
" of age, or woman, shall be employed more than 60 hours in one
" week; and we recommend that all legislation for regulating the hours
" of labour, and the employment of women and minors, be made
" uniform in the several States, excepting in the Province of Quebec,
" where French is spoken generally, where the same degree of efficiency
" should be required in the French or English language, here repre-
" sented. That laws be enacted in all States and Provinces requiring
" that at least 250 cubic feet of air-space be provided for each person
" employed in workshops during the day-time, and 400 cubic feet
" during the night-time, and that adequate means for free ventilation
" be provided, and we deem it advisable that children in our public
" schools be taught the importance of the preservation of health in all
" conditions of life, and a knowledge of the laws of hygiene and
" sanitation."

(Signed) Evan U. Davis (O.).
L. T. Fell (N.J.).
Jos. M. Dyson (Mass.).
John Traney (N.Y.).
Robert Barber (Canada).
W. S. Simmons (Conn.).
Committee.

purpose than an ailing infant that is absorbing capital without much prospect of repaying it. At the same time, I am far from saying that such children are purposely put out of the way, mainly because I have no evidence in support of such an assertion, and so far I am in agreement with the following extract from a report of "the Select Committee on Friendly Societies," contained in the Charity Organisation Review, of January 1890:—"Admitting that insured children are often over-
" laid, or destroyed by improper feeding, we may yet doubt whether
" the insurance is usually the cause of the overlaying and bad feeding.
" The true cause may be simply recklessness or ignorance. Of course
" it cannot be denied that particular children have been done to death
" for the sake of the burial money, but it is an open question whether
" cases of the sort are so common as to justify the legislature in for-
" bidding the insurance of young children. This is a point which may
" be argued indefinitely."

As I have said, with the foregoing quotation I am in agreement; but there is a line at which I think that the legislature is in duty bound to interfere.

The insurance of young children is not universally made in insurance offices such as most persons are familiar with, for I have ascertained, with some trouble, that certain burial societies meet to pay claims and do business at public-houses. This is a matter of some importance. It may be said that it would be a hardship to deprive the poor of the superior pecuniary advantages of mutual insurance, that a proprietary office would have higher rates for the sake of the profits, and that the cheaper insurance society might be allowed to meet free of cost or for a small payment in any place it chose. To this I would make objection (1) that no one wishes to deprive the poor of the benefits of mutual insurance societies; (2) that the mutual societies of which I have information can afford to and do pay their presidents and secretaries for their services, and can probably therefore also afford to pay for rooms in which to transact their business; and (3) that rooms can always be found for these societies to meet in on reasonable terms elsewhere than in public-houses.

The three or four burial societies to which I am referring have these special objections about them, namely, that they meet at public-houses, and that their treasurers are the hosts of the houses.

The moral effect of these circumstances must be considerable, for there is thus always temptation at hand for parents to drown their sorrow and to treat sympathising friends out of the burial claims, and there is also an implied obligation on claimants to spend something for the good of the house, or, in other words, for the good of the treasurer. This obligation, however, is far from being an implied one. I can find no provision in any of the rules of these societies for the payment of the treasurer out of the funds of the societies, as in the case of the presidents and secretaries; on the contrary, the remuneration of the treasurer is particularly ordered to come out of the burial claims which are paid.

To give some idea of the form in which payment is ordered to be made to the treasurer *out of the burial claims*, I quote the following from the printed rules of three *unregistered societies* meeting at public-houses, and having the hosts or hostesses thereof for their treasurers :—

"1. Deducting therefrom for all under 12 months, 2*s.*; above 12, 4*s.*, to be left in the treasurer's hands for such refreshment as the claimant may think proper to take from the house where the society is held; if the claimant takes no refreshments from the house, then the treasurer shall receive the sum of 1*s.* from the above fund for his services.

"2. Deducting therefrom for all under 3*l.*, 2*s.*; 3*l.* and upwards, 4*s.*, to be deposited in the landlord's hands for refreshments of any sort the said claimant may think proper to have from the house where the fund is held. If no refreshments are taken, they shall receive the sum of 3*s.* extra, and leave 1*s.* with the host or hostess. The president, secretary, and senior collector each to have 4*d.* in liquor for each funeral, to be paid out of the society's funds.

"3. Any person becoming a member of this society by observing Rule 9, and paying every collection for one month shall be entitled to the sum of 1*l.*; two months, 2*l.* less 2*s.*, which he or she can have in drink, and a three months' member 3*l.* 6*s.*, and 4*s.* worth of drink, and if a member two years, then he or she shall be entitled to 3*l.* 16*s.* and 4*s.* worth of drink; but if any member at the time of his or her death be two collections in arrears the said member shall forfeit 10*s.*, if three collections 1*l.*, and if four collections he or she to be excluded from all benefits in this society."

The mildest comment that any one could make on these provisions of mutual burial societies must be, that any portion of the insurance or burial money, however small, should be taken out in drink is very objectionable. I am content to take that moderate stand; but I plead that such an objectionable custom, which is quite contrary to the spirit of the age, should be made illegal. The want of decency the rules display is amazing, and it cannot be wondered at if, with such inducements to drown their grief, parents and friends of the deceased ones fail to sustain the genuine article.

On the facts which have been thus brought forward I believe that the legislature should provide,—

(1.) That every mutual insurance society should be registered:

(2.) That no such society should be permitted to meet in any place in which the payment of wages is forbidden under the Truck Act:

(3.) That no chief officer of such a society should have a direct interest in the office of the society:

(4.) That all the chief officers, if remunerated for their services, should be paid out of the funds of the society:

(5.) That no deduction whatever be permitted from the burial or insurance claims by any officer of the society for any purpose whatsoever.

I have thus tried to draw attention to one feature in the subject of infant life insurance which seems to me to be deserving of attention in any endeavour to regulate the manner in which it should be conducted; the whole subject is one of the most difficult with which we have to deal in the present day, for while we cannot shut our eyes to the possibility of evil arising out of it, we must hesitate to thwart forethought and prudence among the poorer classes. I feel certain, however, that the prompt dissociation of burial societies from public-houses will do no harm to legitimate insurance, and I am much surprised that the many powerful advocates of temperance reform in this country have not before this prosecuted a vigorous crusade in that direction.

DISCUSSION.

Dr. H. R. Hutton (Manchester) said: For the last eight years I and my colleagues at the Manchester Children's Hospital have in our annual reports drawn attention to the existence in Manchester and Salford of burial societies which have their head-quarters at public-houses, and which pay some portion of the "death claims" in drink. For a time the mere existence of such a state of things was more than doubted, and I feel that Mr. Paget has earned our hearty thanks for bringing the matter to the notice of this Congress, and for furnishing us with absolute proofs of the truth of his assertions. With a view to strengthening his position, if that were necessary, I have carefully gone through our hospital records, and beg to lay before you the following figures and statistics, which relate entirely to infants and children of not more than 14 years of age:—

In 1884, 71 per cent. of the children who died were insured in some one or more clubs.

In 1885 the percentage was 75.

In 1889, with a total of 251 deaths, 184 were insured, and of these 162 were "in benefit" at the time of death, for an average sum of 3*l.* 4*s.* 7¾*d.* The sum total assured was 523*l.* 13*s.*

In 1890 the average "benefit at death" was 3*l.* 3*s.*

These figures show to how great an extent the practice of insuring the lives of infants and young children prevails in the towns named. In 1889 a very careful inquiry was made into this matter among our out-patients, and a very complete record kept. I find that of the first consecutive 50 children who died in that year, 41 were in benefit at the time of their deaths, and no less than 22 of these, or over 50 per cent., were insured in public-house clubs, or clubs which paid some part of the claim in drink.

At the present moment there are at least six such societies at work in Manchester and Salford.

Nor is this all. Friends and relatives, other than parents, in like manner insure children in these clubs, and I could give many examples of this were I not afraid of unduly occupying the time of the meeting. I may, however, be allowed to give particulars of a few of the most glaring cases:—

(1.) On the death of an infant of one year, the parents receive 4*l.*, and three shillingsworth of drink, from a public-house club.

(2.) On the death of an infant of four months, 30*s.* and one pint of spirits is paid.

(3.) An infant of three months dies, insured in two public-house clubs for a total of 2*l.* 10*s.*

(4.) A baby of two months earns for its parents by its death only 1*l.*, and two shillingsworth of drink.

I will mention but one more. In one family there have been five children, of whom one only now remains; the others have died at the ages of 11 months, 15 months, 21 months, and 11 months respectively. In each case three shillingsworth of drink was given in addition to the insurance money, which amounted to the sum of 17*l.* The father of these children was out of work for a great portion of the time during which these deaths occurred. I was hardly surprised to find the following memorandum on the counterfoil, "Certificate refused; wrote to coroner."

To conclude, then, the facts brought to your notice by Mr. Paget and myself prove, I think—1. The frequency of infant life assurance. 2. The prevalence of insurance in public-house clubs. 3. The commonness of the practice of accepting drink in part payment of claims.

And, while not saying or even believing that the practices here condemned lead parents to do away with their infants, I do think that the facts revealed point to the existence of a real and great evil. The dread of a "pauper funeral" is both a natural and a salutary one, which is entirely removed by this ready method of providing a sum of money, greatly exceeding, in many cases, the costs of the funeral; while, combined with the specially objectionable practice to which I have referred, this form of infant life assurance, in my opinion, directly encourages reckless and improvident marriages, neglect, and intemperance.

Defective Personal Hygiene as it affects the Teeth in Infancy, Childhood, and School Life.

BY

GEO. CUNNINGHAM, M.A., Lecturer on Dental Surgery in the University of Cambridge.

It would be impossible to exaggerate the value of a good set of teeth in a healthy mouth, and that whether the denture is regarded as an important organ of digestion, as a valuable factor in the mechanism of speech, or as a decorative appendage which adds to the beauty or attractiveness of its owner's appearance. Yet there is, probably, no portion of the physical economy which is so generally and systematically neglected. It is not surprising, therefore, that the digestion, the speech, and the appearance of the bulk of the community are most seriously affected by this general carelessness, which is only equalled by the ignorance from which it arises.

Caries is the scientific name of the disease which leads to the wholesale disintegration of the tissues of the teeth which are the hardest structures entering into man's composition. Its injurious effects are enormously increased by the fact, that if neglected it almost inevitably leads to a train of diseases which have the greatest influence upon the well-being of the entire organism.

A communication, read to the British Dental Association in 1885, advocating compulsory attention to the teeth of school children, originated a movement which has gone on with increasing force and influence ever since. The practical outcome of this movement was the appointment of a committee to arrange a uniform scheme of investigation as to the condition of the teeth of school children throughout the country, in order to obtain statistics for the following purposes :—Firstly, to acquire a more exact knowledge of the condition of children's teeth at various ages ; and, secondly, to show by means of the facts thus acquired, the disabilities under which children frequently suffer in their growth and development, and the important bearing this condition has upon the future health of the individual.

This investigation is still far from being complete, but a sufficient number of examinations of a reliable nature have been made to prove the almost appalling frequency of dental caries and other diseases of the mouth, especially during the period of school life.

The frequency of caries is due to a variety of conditions which may be assigned to two distinct categories, the one intrinsic and the other extrinsic. Intrinsic conditions are those which arise from incomplete development, deficient nutrition, or the mal-position of individual or of several teeth, and which, by lowering the co-efficient of resistance, offer special points of attack. They must, therefore, be regarded as predisposing conditions in contradistinction to all extrinsic agencies.

Faulty structure of the teeth is the most important of all the predisposing causes of dental caries. Just as a lump of table salt dissolves more rapidly in water on account of its porosity than an equally large piece of rock salt, so porous dentine is more rapidly decalcified than well developed, firm dentine, because the acid can more rapidly penetrate the tissue, and because less acid is required to complete the decalcification.

Deep fissures are usually found on the grinding surfaces of the bicuspid and molar teeth, frequently on the lingual surfaces of the front teeth and more rarely on other surfaces. These naturally favour a continual retention of food particles and thus induce caries, from the absence of an intact covering of enamel. If the enamel itself is also poorly developed then the advance of disease will be all the more rapid. Not infrequently, owing to some inflammation while the tooth is being formed, the enamel instead of being evenly distributed over the dentine presents a pitted or deeply furrowed surface. These teeth besides being, as a rule weak, are extremely unsightly, and are commonly known as honeycombed teeth. Occasionally these teeth have a high co-efficient of resistance, in which case they are strong but extremely ugly.

A crowded condition or an irregular position of the teeth in the jaws predisposes to decay by forming spaces which favour the accumulation and retention of fermenting and acid-forming substances in contact with the enamel; in this connexion the form of the teeth is not without considerable influence, as teeth with convex contiguous surfaces, by having their points of attack reduced to a minimum, are relatively less subject to caries than teeth with flat or slightly concave

surfaces. Many of these irregularities are entirely due to preventable causes, two of which are especially important as affecting that period of life to which the consideration of the subject is at present necessarily limited.

Premature loss of temporary teeth is probably the cause of some irregularities, but it is completely overshadowed by the more disastrous effects of their undue retention. The roots of the deciduous teeth are not always completely removed by the natural process, and the successional tooth is thereby frequently diverted from assuming its natural position in the arch. More serious effects, however, are produced by the retention of temporary teeth, usually in a carious condition, and frequently accompanied by a chronic abscess formation, which originated in neglected caries. Undue retention of the temporary teeth must be regarded as a predisposing cause of caries, if only from the fact that it favours the retention of fermentable matter, since the teeth cannot be kept clean either spontaneously by the tongue, or in mastication, or artificially by the application of the tooth-brush.

A recession or loosening of the gums from neglect of the teeth not only lays bare the dentine, but also permits the entrance of food particles round the necks of the teeth or into pockets formed by the loosening of the gums by which means a further predisposing cause for caries is furnished. This condition is most characteristic of a later period of life than that with which we are presently concerned, but the results of the examinations of the teeth of school children prove that although this condition is relatively infrequent, it is occasionally found at this early life, when it is usually accompanied by deposits of tartar, which may be of very considerable quantity. Such a condition is entirely due to defective personal hygiene of the mouth. Many of the teeth of the school children examined show that they were in many instances remarkably clean, although they were absolutely innocent of the application of the tooth-brush, which conclusively proves that mastication properly performed and aided by the movements of the lips and tongue is a highly important factor in keeping the teeth clean, and the mouth in a healthy condition.

Many believe that a predisposition to caries may be inherited. It cannot be denied that badly-developed, irregular teeth are inherited; and, so far, inheritance may be considered as a predisposing cause of caries.

With regard to general diseases which are often described as predisposing causes, we adopt Miller's view that they should rather be regarded as "exciting causes of caries by imparting an acid reaction "to the buccal juices."

Many authorities, notably Galippe and Magitot, in France, and Harlan, Sitherwood, and Kingsley, in America, regard excessive intellectual work during childhood and adolescence as an important factor in promoting the frequency of caries. Galippe has pointed out that, while we make laws in order to prevent children working in factories at an early age, little or no heed is paid to those other factories usually known as "schools," in which pupils submit spontaneously to, or are

" which it has been applied. On the contrary, the progress of manu-
" facture has apparently been entirely unimpeded by the Factory Acts;
" and there are but few, even amongst the employers, who would now
" wish to repeal the main provisions of the Acts, or would deny the
" benefit which has resulted from them."

I do not care to discount the distant future, when those able to work will, by common consent, be compelled to contribute their share to the required production of material and intellectual goods, when the working power of millions of able-bodied men will no longer be spent on the gorgeous display of alleged preparations for war, and other millions will no longer waste time and opportunities on distributing goods by waiting for, and on, customers; and when the labour necessary for the accumulation of products will be no longer demanded from those who would serve society better by first developing their physical and intellectual powers. Therefore, for the time being, we have every reason to greet with satisfaction the wisdom of additional legislation, as suggested by the Committee on Resolutions, of the Fourth Annual Convention of the International Association of Inspectors of Factories and Workshops of North America held at New York City, August 27–30, 1890, in the following words:—" To prevent the employment of
" children in factories, workshops, and mercantile establishments under
" 14 years of age, and compelling all children of such age, and all
" unable to read and write intelligibly the English language under
" the age of 16 years, to attend some public or private school until so
" qualified. To prevent the employment of any child under 16 years
" of age in any hazardous occupation, or in which its health is liable
" to be impaired, or its morals corrupted, and the employment of any
" minor under 18 years of age, or of any woman later than 9 p.m. or
" earlier than 6 a.m. of any day, and that no minor under 18 years
" of age, or woman, shall be employed more than 60 hours in one
" week; and we recommend that all legislation for regulating the hours
" of labour, and the employment of women and minors, be made
" uniform in the several States, excepting in the Province of Quebec,
" where French is spoken generally, where the same degree of efficiency
" should be required in the French or English language, here repre-
" sented. That laws be enacted in all States and Provinces requiring
" that at least 250 cubic feet of air-space be provided for each person
" employed in workshops during the day-time, and 400 cubic feet
" during the night-time, and that adequate means for free ventilation
" be provided, and we deem it advisable that children in our public
" schools be taught the importance of the preservation of health in all
" conditions of life, and a knowledge of the laws of hygiene and
" sanitation."

(Signed) Evan U. Davis (O.).
L. T. Fell (N.J.).
Jos. M. Dyson (Mass.).
John Traney (N.Y.).
Robert Barber (Canada).
W. S. Simmons (Conn.).
Committee.

An objectionable Feature of some Burial Societies in their relation to Infant Life Insurance.

BY

CHARLES E. PAGET, M.R.C.S., D.P.H., Medical Officer of Health for the County Borough of Salford.

As medical officer of health for a large manufacturing borough, the regular occurrence within it of an excessive infant mortality has necessarily occupied much of my attention.

The mere fact that female labour is at a premium in a manufacturing town opens up at once many roads by which the questions relating to the possible causes of high infantile mortality may be approached. It is, moreover, very difficult to separate one special cause for such mortality from those more common and more easily recognisable causes which are known under the headings of hereditary predisposition, food, want of cleanliness of air, soil, and water, and seasonal diseases.

In the course of my inquiries, however, I was naturally led to consider the possible influence of infant insurance as a predisposing cause of infant mortality, and though I am unable to bring forward evidence of a decided character in this respect, yet there are certain circumstances in connexion with the conduct of some burial societies which it seems to me ought to be more widely recognised and considered in relation to the main question.

A high infant mortality is common in large towns, but it is usually greatly aggravated in large manufacturing towns; it is also in large towns that indiscriminate infant life insurance is under the least restriction. In the first place, there is more scope for the collectors of a society in a town than in a country district, and more chance of their making something of a living out of the collection of dues and the increase in membership. But, besides, in country districts there is too great a knowledge of one neighbour's affairs by another, and too many petty jealousies, for suspicious proceedings, even within a family circle, to be passed over without comment. In a larger community, on the other hand, there is a tendency towards a closer union, the consequence of a harder struggle for existence under unfavourable surroundings and arising also in respect of wage and other social matters; there may also possibly be a common sympathy over the difficulties and the troubles of infant rearing in large urban districts. Anyhow, it does appear as if there was a smaller sense of parental responsibility in towns than in country districts, and certainly when the mother is herself a wage-earner that is an adverse condition against which a weakly child has further to contend in its struggle for existence.

The temptation to make capital out of weakly infant lives must be, among some of the poorer classes in large towns, a far greater one than most people can estimate, for to them the immediate possession of a sum of money equal to or double a week's wages is probably more to the

purpose than an ailing infant that is absorbing capital without much prospect of repaying it. At the same time, I am far from saying that such children are purposely put out of the way, mainly because I have no evidence in support of such an assertion, and so far I am in agreement with the following extract from a report of "the Select Committee on Friendly Societies," contained in the Charity Organisation Review, of January 1890:—"Admitting that insured children are often over-
" laid, or destroyed by improper feeding, we may yet doubt whether
" the insurance is usually the cause of the overlaying and bad feeding.
" The true cause may be simply recklessness or ignorance. Of course
" it cannot be denied that particular children have been done to death
" for the sake of the burial money, but it is an open question whether
" cases of the sort are so common as to justify the legislature in for-
" bidding the insurance of young children. This is a point which may
" be argued indefinitely."

As I have said, with the foregoing quotation I am in agreement; but there is a line at which I think that the legislature is in duty bound to interfere.

The insurance of young children is not universally made in insurance offices such as most persons are familiar with, for I have ascertained, with some trouble, that certain burial societies meet to pay claims and do business at public-houses. This is a matter of some importance. It may be said that it would be a hardship to deprive the poor of the superior pecuniary advantages of mutual insurance, that a proprietary office would have higher rates for the sake of the profits, and that the cheaper insurance society might be allowed to meet free of cost or for a small payment in any place it chose. To this I would make objection (1) that no one wishes to deprive the poor of the benefits of mutual insurance societies; (2) that the mutual societies of which I have information can afford to and do pay their presidents and secretaries for their services, and can probably therefore also afford to pay for rooms in which to transact their business; and (3) that rooms can always be found for these societies to meet in on reasonable terms elsewhere than in public-houses.

The three or four burial societies to which I am referring have these special objections about them, namely, that they meet at public-houses, and that their treasurers are the hosts of the houses.

The moral effect of these circumstances must be considerable, for there is thus always temptation at hand for parents to drown their sorrow and to treat sympathising friends out of the burial claims, and there is also an implied obligation on claimants to spend something for the good of the house, or, in other words, for the good of the treasurer. This obligation, however, is far from being an implied one. I can find no provision in any of the rules of these societies for the payment of the treasurer out of the funds of the societies, as in the case of the presidents and secretaries; on the contrary, the remuneration of the treasurer is particularly ordered to come out of the burial claims which are paid.

To give some idea of the form in which payment is ordered to be made to the treasurer *out of the burial claims*, I quote the following from the printed rules of three *unregistered societies* meeting at public-houses, and having the hosts or hostesses thereof for their treasurers :—

"1. Deducting therefrom for all under 12 months, 2*s.*; above 12, 4*s.*, to be left in the treasurer's hands for such refreshment as the claimant may think proper to take from the house where the society is held; if the claimant takes no refresh ments from the house, then the treasurer shall receive the sum of 1*s.* from the above fund for his services.

"2. Deducting therefrom for all under 3*l.*, 2*s.*; 3*l.* and upwards, 4*s.*, to be deposited in the landlord's hands for refreshments of any sort the said claimant may think proper to have from the house where the fund is held. If no refreshments are taken, they shall receive the sum of 3*s.* extra, and leave 1*s.* with the host or hostess. The president, secretary, and senior collector each to have 4*d.* in liquor for each funeral, to be paid out of the society's funds.

"3. Any person becoming a member of this society by observing Rule 9, and paying every collection for one month shall be entitled to the sum of 1*l.*; two months, 2*l.* less 2*s.*, which he or she can have in drink, and a three months' member 3*l.* 6*s.*, and 4*s.* worth of drink, and if a member two years, then he or she shall be entitled to 3*l.* 16*s.* and 4*s.* worth of drink; but if any member at the time of his or her death be two collections in arrears the said member shall forfeit 10*s.*, if three collections 1*l.*, and if four collections he or she to be excluded from all benefits in this society."

The mildest comment that any one could make on these provisions of mutual burial societies must be, that any portion of the insurance or burial money, however small, should be taken out in drink is very objectionable. I am content to take that moderate stand; but I plead that such an objectionable custom, which is quite contrary to the spirit of the age, should be made illegal. The want of decency the rules display is amazing, and it cannot be wondered at if, with such inducements to drown their grief, parents and friends of the deceased ones fail to sustain the genuine article.

On the facts which have been thus brought forward I believe that the legislature should provide,—

(1.) That every mutual insurance society should be registered:

(2.) That no such society should be permitted to meet in any place in which the payment of wages is forbidden under the Truck Act:

(3.) That no chief officer of such a society should have a direct interest in the office of the society:

(4.) That all the chief officers, if remunerated for their services, should be paid out of the funds of the society:

(5.) That no deduction whatever be permitted from the burial or insurance claims by any officer of the society for any purpose whatsoever.

I have thus tried to draw attention to one feature in the subject of infant life insurance which seems to me to be deserving of attention in any endeavour to regulate the manner in which it should be conducted; the whole subject is one of the most difficult with which we have to deal in the present day, for while we cannot shut our eyes to the possibility of evil arising out of it, we must hesitate to thwart forethought and prudence among the poorer classes. I feel certain, however, that the prompt dissociation of burial societies from public-houses will do no harm to legitimate insurance, and I am much surprised that the many powerful advocates of temperance reform in this country have not before this prosecuted a vigorous crusade in that direction.

DISCUSSION.

Dr. H. R. Hutton (Manchester) said: For the last eight years I and my colleagues at the Manchester Children's Hospital have in our annual reports drawn attention to the existence in Manchester and Salford of burial societies which have their head-quarters at public-houses, and which pay some portion of the "death claims" in drink. For a time the mere existence of such a state of things was more than doubted, and I feel that Mr. Paget has earned our hearty thanks for bringing the matter to the notice of this Congress, and for furnishing us with absolute proofs of the truth of his assertions. With a view to strengthening his position, if that were necessary, I have carefully gone through our hospital records, and beg to lay before you the following figures and statistics, which relate entirely to infants and children of not more than 14 years of age:—

In 1884, 71 per cent. of the children who died were insured in some one or more clubs.

In 1885 the percentage was 75.

In 1889, with a total of 251 deaths, 184 were insured, and of these 162 were "in benefit" at the time of death, for an average sum of 3*l.* 4*s.* 7¾*d.* The sum total assured was 523*l.* 13*s.*

In 1890 the average "benefit at death" was 3*l.* 3*s.*

These figures show to how great an extent the practice of insuring the lives of infants and young children prevails in the towns named. In 1889 a very careful inquiry was made into this matter among our out-patients, and a very complete record kept. I find that of the first consecutive 50 children who died in that year, 41 were in benefit at the time of their deaths, and no less than 22 of these, or over 50 per cent., were insured in public-house clubs, or clubs which paid some part of the claim in drink.

At the present moment there are at least six such societies at work in Manchester and Salford.

Nor is this all. Friends and relatives, other than parents, in like manner insure children in these clubs, and I could give many examples of this were I not afraid of unduly occupying the time of the meeting. I may, however, be allowed to give particulars of a few of the most glaring cases:—

(1.) On the death of an infant of one year, the parents receive 4*l.*, and three shillingsworth of drink, from a public-house club.

(2.) On the death of an infant of four months, 30*s.* and one pint of spirits is paid.

(3.) An infant of three months dies, insured in two public-house clubs for a total of 2*l.* 10*s.*

(4.) A baby of two months earns for its parents by its death only 1*l.*, and two shillingsworth of drink.

I will mention but one more. In one family there have been five children, of whom one only now remains; the others have died at the ages of 11 months, 15 months, 21 months, and 11 months respectively. In each case three shillingsworth of drink was given in addition to the insurance money, which amounted to the sum of 17*l.* The father of these children was out of work for a great portion of the time during which these deaths occurred. I was hardly surprised to find the following memorandum on the counterfoil, "Certificate refused; wrote to coroner."

To conclude, then, the facts brought to your notice by Mr. Paget and myself prove, I think—1. The frequency of infant life assurance. 2. The prevalence of insurance in public-house clubs. 3. The commonness of the practice of accepting drink in part payment of claims.

And, while not saying or even believing that the practices here condemned lead parents to do away with their infants, I do think that the facts revealed point to the existence of a real and great evil. The dread of a "pauper funeral" is both a natural and a salutary one, which is entirely removed by this ready method of providing a sum of money, greatly exceeding, in many cases, the costs of the funeral; while, combined with the specially objectionable practice to which I have referred, this form of infant life assurance, in my opinion, directly encourages reckless and improvident marriages, neglect, and intemperance.

Defective Personal Hygiene as it affects the Teeth in Infancy, Childhood, and School Life.

BY

GEO. CUNNINGHAM, M.A., Lecturer on Dental Surgery in the University of Cambridge.

It would be impossible to exaggerate the value of a good set of teeth in a healthy mouth, and that whether the denture is regarded as an important organ of digestion, as a valuable factor in the mechanism of speech, or as a decorative appendage which adds to the beauty or attractiveness of its owner's appearance. Yet there is, probably, no portion of the physical economy which is so generally and systematically neglected. It is not surprising, therefore, that the digestion, the speech, and the appearance of the bulk of the community are most seriously affected by this general carelessness, which is only equalled by the ignorance from which it arises.

Caries is the scientific name of the disease which leads to the wholesale disintegration of the tissues of the teeth which are the hardest structures entering into man's composition. Its injurious effects are enormously increased by the fact, that if neglected it almost inevitably leads to a train of diseases which have the greatest influence upon the well-being of the entire organism.

A communication, read to the British Dental Association in 1885, advocating compulsory attention to the teeth of school children, originated a movement which has gone on with increasing force and influence ever since. The practical outcome of this movement was the appointment of a committee to arrange a uniform scheme of investigation as to the condition of the teeth of school children throughout the country, in order to obtain statistics for the following purposes:—Firstly, to acquire a more exact knowledge of the condition of children's teeth at various ages; and, secondly, to show by means of the facts thus acquired, the disabilities under which children frequently suffer in their growth and development, and the important bearing this condition has upon the future health of the individual.

This investigation is still far from being complete, but a sufficient number of examinations of a reliable nature have been made to prove the almost appalling frequency of dental caries and other diseases of the mouth, especially during the period of school life.

The frequency of caries is due to a variety of conditions which may be assigned to two distinct categories, the one intrinsic and the other extrinsic. Intrinsic conditions are those which arise from incomplete development, deficient nutrition, or the mal-position of individual or of several teeth, and which, by lowering the co-efficient of resistance, offer special points of attack. They must, therefore, be regarded as predisposing conditions in contradistinction to all extrinsic agencies.

Faulty structure of the teeth is the most important of all the predisposing causes of dental caries. Just as a lump of table salt dissolves more rapidly in water on account of its porosity than an equally large piece of rock salt, so porous dentine is more rapidly decalcified than well developed, firm dentine, because the acid can more rapidly penetrate the tissue, and because less acid is required to complete the decalcification.

Deep fissures are usually found on the grinding surfaces of the bicuspid and molar teeth, frequently on the lingual surfaces of the front teeth and more rarely on other surfaces. These naturally favour a continual retention of food particles and thus induce caries, from the absence of an intact covering of enamel. If the enamel itself is also poorly developed then the advance of disease will be all the more rapid. Not infrequently, owing to some inflammation while the tooth is being formed, the enamel instead of being evenly distributed over the dentine presents a pitted or deeply furrowed surface. These teeth besides being, as a rule weak, are extremely unsightly, and are commonly known as honeycombed teeth. Occasionally these teeth have a high co-efficient of resistance, in which case they are strong but extremely ugly.

A crowded condition or an irregular position of the teeth in the jaws predisposes to decay by forming spaces which favour the accumulation and retention of fermenting and acid-forming substances in contact with the enamel; in this connexion the form of the teeth is not without considerable influence, as teeth with convex contiguous surfaces, by having their points of attack reduced to a minimum, are relatively less subject to caries than teeth with flat or slightly concave

surfaces. Many of these irregularities are entirely due to preventable causes, two of which are especially important as affecting that period of life to which the consideration of the subject is at present necessarily limited.

Premature loss of temporary teeth is probably the cause of some irregularities, but it is completely overshadowed by the more disastrous effects of their undue retention. The roots of the deciduous teeth are not always completely removed by the natural process, and the successional tooth is thereby frequently diverted from assuming its natural position in the arch. More serious effects, however, are produced by the retention of temporary teeth, usually in a carious condition, and frequently accompanied by a chronic abscess formation, which originated in neglected caries. Undue retention of the temporary teeth must be regarded as a predisposing cause of caries, if only from the fact that it favours the retention of fermentable matter, since the teeth cannot be kept clean either spontaneously by the tongue, or in mastication, or artificially by the application of the tooth-brush.

A recession or loosening of the gums from neglect of the teeth not only lays bare the dentine, but also permits the entrance of food particles round the necks of the teeth or into pockets formed by the loosening of the gums by which means a further predisposing cause for caries is furnished. This condition is most characteristic of a later period of life than that with which we are presently concerned, but the results of the examinations of the teeth of school children prove that although this condition is relatively infrequent, it is occasionally found at this early life, when it is usually accompanied by deposits of tartar, which may be of very considerable quantity. Such a condition is entirely due to defective personal hygiene of the mouth. Many of the teeth of the school children examined show that they were in many instances remarkably clean, although they were absolutely innocent of the application of the tooth-brush, which conclusively proves that mastication properly performed and aided by the movements of the lips and tongue is a highly important factor in keeping the teeth clean, and the mouth in a healthy condition.

Many believe that a predisposition to caries may be inherited. It cannot be denied that badly-developed, irregular teeth are inherited; and, so far, inheritance may be considered as a predisposing cause of caries.

With regard to general diseases which are often described as predisposing causes, we adopt Miller's view that they should rather be regarded as "exciting causes of caries by imparting an acid reaction " to the buccal juices."

Many authorities, notably Galippe and Magitot, in France, and Harlan, Sitherwood, and Kingsley, in America, regard excessive intellectual work during childhood and adolescence as an important factor in promoting the frequency of caries. Galippe has pointed out that, while we make laws in order to prevent children working in factories at an early age, little or no heed is paid to those other factories usually known as "schools," in which pupils submit spontaneously to, or are

coerced into, intense mental work, with a view to some examination which crowns their studies or decides their future career. There is, on the whole, good ground for believing, as these authorities maintain, that premature or excessive intellectual work reacts upon the constitution of the teeth, and that in pupils whose scholastic success is very remarkable, caries is extremely frequent.

The extrinsic agencies producing caries include the result of such general diseases as scrofula, rachitis, dyspepsia, fever, and others such as rheumatism, gout, &c., not usually associated with the period of school life. Any disease (local or general) which has the effect of acidifying the saliva, should be regarded as an exciting cause of caries, and therefore demanding special attention to the condition of the mouth, with a view to the neutralisation of the saliva. Increased attention should, therefore, be devoted to the hygienic care of the mouth during sickness, instead of which even ordinary precautions are relaxed. Even when the patient is incapable of using a tooth-brush, his comfort will be increased by having the mouth rinsed by an antiseptic wash.

The chief exciting cause is the chemical change produced by micro-organisms in the fermentable matter lodged upon and between the teeth. Caries is, therefore, "a chemico-parasitical process consisting "of two distinctly marked stages; first, decalcification, or softening of "the tissue, and, secondly, dissolution of the softened residue." The acids, which effect the decalcifications, are derived almost entirely from amylaceous and saccharine substances, retained in the fissures and defects, or on the surfaces of the teeth, and which undergo fermentation there. It is no new idea to regard the acids formed from sugar as being especially injurious to the teeth. Miller considers that starch and amylaceous substances are much more detrimental to the teeth than sugar, particularly as sugar being readily soluble is soon carried away, or is so diluted with the saliva as to be rendered harmless, whereas amylaceous matter adheres to the teeth for a greater length of time, and consequently exercises a more continued action than sugar. Fermentable albuminous substances mixed with the saliva, develop but small quantities of acids which soon disappear.

"The second stage of caries, namely, the dissolution of the "softened dentine by bacteria, is directly detectable under the "microscope, and may be easily accomplished experimentally." The albuminous substance contained in the dentine forms, indeed, an excellent medium for the growth of bacteria, with the result that the soft tooth tissue is dissolved by the bacteria ferment, much as white of egg is by the gastric juice. The rapidity with which the process of destruction of the teeth advances in any mouth, is evidently directly proportional to the intensity of the fermentation going on in the cavities or spaces where the food is retained, and inversely proportional to the power of resistance of the tooth substances.

The main points to be remembered are that caries is due to extrinsic or external causes which proceed from without inwards, and that as they affect most rapidly and completely those tissues which are richest in organic matter, the dentine of which the bulk of the tooth is

composed is more quickly destroyed than the enamel; and, further, that the action of micro-organisms plays by far the chief rôle in the production of caries. In a scientifically clean mouth, therefore, there can be no caries. Prophylactic precautions, then, must consist in judicious efforts to sterilise the mouth, for it is obviously impossible to confine the diet to albuminous fermentable substances, such as flesh, eggs, &c.

With the appearance of the teeth arises the necessity for the application of personal hygienic precautions. In determining the necessity for these precautions, the mouth may be regarded as an incubator, in which, not only are the conditions of heat, humidity, and oxidation perfectly realised, but bacteria and a nutritive medium are almost inevitably constantly present. Having thus acquired some idea of the nature of the disease, and of the causes by which it is produced, it is well worth considering how far these latter are under our control, especially as related to the period of life with which we are more immediately concerned.

Faulty structure is mostly dependent upon constitutional conditions both of the parent and the child during the earliest part of the formation period of the teeth, and therefore is very largely beyond our control. It is important to remember, however, that, although the period of development begins particularly early in life, it is more or less actively continuous to a relatively late age, as the process of calcification, which begins some five months before birth, is not really complete until the age of about twenty. It is evident, therefore, that much may yet be done to improve the quality of the tooth structure, even although some injuries and defects be already beyond repair. Both the bones and teeth, containing as they do a large percentage of earthy matter, necessarily require during the period of their growth a very liberal supply to the blood of those constructive substances which can only be derived from the food.

Those food stuffs best calculated to promote the formation of strong teeth should be prominent in the dietary of infants and children. It would take too long to discuss the most appropriate dietary, suffice it to remember that the chief article of food, the so-called staff of life, is made somewhat of a broken reed by the senseless practice of measuring its quality by its whiteness. The production of this very whiteness necessarily means an exclusion of that portion of the wheat which is richest in nitrogenous and earthy matter; while again, a dark or brown colour is no certain test of its dietetic value, for much of the so-called whole meal or brown bread is but a commercial fraud. The bread as made for and supplied to our prisons may be taken as a type of what wholesome bread ought to be. As oatmeal is a well recognised and wholesome article of diet, it should be remembered that while the removal of the finer bran from wheat reduces the amount of nitrogenous and fatty contents of the flour, the removal of the husks from oats has precisely the opposite effect, so that the finer the oatmeal the richer it is in those ingredients.

It is also important that the food should offer to the teeth a salutary resistance which they must overcome, since the mechanical action

exercised by such food stuffs has the very best effect upon the tooth structure. It is a well recognised law of general application that every organ which we do not use ends by becoming atrophied from loss of its functional energy. The more the teeth are used in mastication the better will they be able to stand the attacks which they must inevitably encounter. If this is once rightly apprehended the importance of the first teeth becomes strikingly obvious, for, as the "Lancet," commenting on Mr. Fisher's plea for the compulsory attention to the teeth of school children, says, in discussing this question: "If we wish to get "at the root of the evil we must commence our treatment with the "deciduous teeth. Many patients—nay, even medical practitioners— "ask, what is the use of preserving teeth which have only to serve their "purpose for a time, and which nature will replace? If a surgeon "were asked what is the use of provisional callus in a case of fracture "his answer would be readily formulated, and just such an answer is "applicable to the teeth. We will run over just a few of the points "that may result from disease of the teeth and its neglect. First, with "regard to the child's health, with decayed teeth and often in addition "chronic gumboils, the little sufferer is kept awake at night and his diges- "tion affected by inability to masticate his food, and more so by swallow- "ing the fetid discharges from the abscesses. As a consequence the "child becomes weak and puny, and so the already developing teeth suffer "from the constitutional disturbance. Supposing each tooth as it becomes "the seat of disease is extracted, then the masticatory power is greatly "enfeebled, and moreover it has been shown that where many deciduous "teeth have been removed, especially in the case of the canines, the "jaw does not develope as rapidly as it should do, and consequently "when the permanent teeth erupt, some take their position inside and "some outside the arch, which irregularity is a potent predisposing "cause of caries, apart from its unsightliness. Again, take for instance "a very common case, that of the second temporary molar extensively "decayed. The first permanent molar assumes its due position "posterior, and the first bicuspid anterior to it. Both these permanent "teeth are frequently found affected on the side corresponding with "the diciduous tooth, and the disease is undoubtedly due to the infection "from decomposing food harboured by it. Although much more might "be said upon this subject, we think that enough has been advanced "to show the importance of the first teeth with reference to the welfare "of their successors, which should, but so often do not, do duty for a "lifetime. We believe that nothing short of the periodical examination "every six months, and treatment if necessary, of the teeth of children "can effectually cope with this evil."

Further means by which we can counteract or limit the ravages of caries are well summed up by Miller, who is our greatest authority on the action of micro-organisms of the human mouth: "By repeated "thorough systematic cleansing of the oral cavity and the teeth, to so "far reduce the amount of fermentable matter as to materially diminish "the production of acid as well as to rob the bacteria of the organic "matter necessary to their development; by prohibiting the consump-

" tion of such foods and luxuries as readily undergo rapid fermenta-
" tion, to remove the chief source of the ferment-products injurious to
" the teeth; and lastly by a proper and intelligent use of antiseptics to
" destroy the bacteria and to limit their number and activity."

Mechanical cleansing exercises a great influence upon the process of fermentation in the human mouth; and, therefore, as soon as the temporary set of teeth is fully erupted, a suitable tooth-brush supplies the best method of cleansing, which operation should be performed daily, the most efficient time being after meals.

Efficient use of the temporary teeth in mastication is important in order that both the permanent teeth and the jaws may be made stronger and better developed; it is imperative to see that no crusts of bread are left or disposed of by being dipped in tea or any other similar fluid. Statistics prove that the state of the first teeth is, in something like two-thirds of the infants examined, already such that by the fourth and fifth year their masticatory powers are seriously impaired.

Any thorough system of prophylaxis must include periodical examination of the teeth by a competent dental practitioner, more especially as the arrest of caries is, generally speaking, easy of accomplishment, if only it is taken in time, which is usually long before the process has signalled its presence by the causation of pain. If the child's denture is in such a condition that efficient use causes uneasiness or pain, it is a sign that the case requires urgent attention.

The tooth-brush is too frequently used improperly, the action being confined to a more or less superficial application of it to the external or labial surfaces of the teeth with a to-and-fro motion. Its proper application consists in its being applied to all the surfaces of the teeth as far as possible. A rotary motion is the most effective, since the to-and-fro motions merely polish the surfaces which the motions of the lips, cheek, and tongue keep tolerably clean. The brush should be made, first of all, to impinge upon the gum, and then be carried towards the masticating surfaces with a rotary motion. The upper teeth must therefore be brushed from the gum downwards and the lower from the gum upwards. The to-and-fro motion will suffice for the cleansing of the masticatory surfaces.

With regard to the kind of tooth-brush, a round handle facilitates the rotary movement and the bristles should be of medium stiffness, not too hard, otherwise the gums may be unduly lacerated. By dipping the brush into hot water the bristles may be softened to the proper consistency. It should be remembered, however, that one is more likely to err in the selection of too soft rather than too hard a tooth-brush. Brushes with soft bristles are bad, and words are not strong enough to describe the stupidity of employing such a "make believe" as the badger-hair brush. As a rule, most tooth-brushes are made with an unnecessary number of bristles, and the bundles of bristles are too close together, where they are inserted into the back of the brush. Such brushes soon become clogged towards the back with an objectionable mass of tooth-powder, epithelial scales, and food débris. The india-rubber tooth-brush is also of comparatively little use for cleansing

purposes. The tooth-brush should never be enclosed in that wretched piece of toilet ware, known as the tooth-brush tray; after use, the tooth-brush should be dried on a towel and placed in a rack or jar to drain and allowed to dry freely exposed to the air and sunlight.

Frequently the use of the tooth-brush becomes perfunctory or is given up entirely, because of the gums bleeding. The more the gums bleed on brushing the greater is the necessity of not only continuing the brushing but of increasing the vigour of its application. Any extreme readiness of the gums to bleed is the sure indication of their being in a diseased state, and the vigorous brushing, with the consequent bleeding, will usually bring the gums into a healthy tonic condition, in which they present no tendency to bleed.

Even if the tooth-brush is applied in the most thorough manner, it is difficult to prevent the lodgment of fermentable matter between the proximal surfaces of the teeth. Waxed floss silk may be introduced between even the closest teeth, and, as it is gently drawn to and fro towards the neck of the tooth, surfaces are cleaned which would never be reached by the tooth-brush. Ordinary embroidery, or skein silk, cut into short lengths and drawn across a piece of hard beeswax is quite as efficient, and much less expensive, than the spools of wax floss silk, especially made for dental purposes. Short lengths of india-rubber, square or round, such as is used in the manufacture of elastic webbing, will also act in a similarly efficient way; by being stretched, it passes between the teeth at the masticating surfaces, and on the tension being relieved it fills up the larger spaces towards the next, and as it is drawn through removes the débris.

Where teeth are placed somewhat apart, or where teeth stand alone, short lengths of ordinary thin narrow linen tape will be found efficient agents, while narrow silk tape, also well waxed, would be better where the teeth are closer. Narrow strips of tracing cloth, such as is used by architects, is another material which may be used either with or without being waxed, and has the advantage of being waterproof. Where the tendency for the formation of tartar is great the charging of the ligature or the band with tooth-powder will do much to prevent the formation of deposits, presuming, of course, that the teeth have been first of all scaled. Such a cleansing as this will take a considerable time for its proper execution, and, if the ordinary daily cleansings are thoroughly carried out, the more extensive processes of cleansing need only be performed at longer intervals, say about once or twice a week. The importance of attention to the cleansing of the proximal surface is apparent when we know that, with the exception of the grinding surfaces of the molars, the majority of the cavities of decay are on these surfaces.

The use of the toothpick is unfortunately essential to the comfort of some adults, but it should not be thought of as a cleansing instrument for the teeth of children.

If one starts with clean teeth, the teeth may be kept fairly clean by means of the tooth-brush, plain water, and floss silk, and "time," much time being given to the operation. In the light of our increased

knowledge as to the etiology of dental caries the particular value laid on tooth-powder tends rather to decrease than to increase. There can be no doubt, however, that the use of a tooth-powder greatly facilitates the retention of the natural colour of the teeth, which I think is a better way to put it than using the stereotyped expression that the use of a tooth-powder makes the teeth whiter; that a good tooth-powder does not and should not do. All that may be reasonably expected of it is that it will remove, by mechanical friction, stains and discolourations obscuring the natural colour of the teeth, which is after all far from being white.

The principal action of a tooth-powder, then, is mechanical rather than medicinal. It is important, however, to regulate its frictional power. The powder should be very finely grained, and not gritty, therefore it should contain no cuttle-fish powder, no powdered oyster shells, no pumice powder, since these substances are too mechanical in their action. It should consist of alkaline substances, and must contain no acid ingredients, or such as are capable of changing to acids in the mouth, since these are extremely destructive to tooth structure.

The presence of an antiseptic agent in the tooth-powder is desirable. Some antiseptic ingredients of tooth-powder are, however, to be condemned, for instance, charcoal and charred bread, although both antiseptic and frictional, are too gritty, and from constant use leads to the formation of a permanent bluish border to the gum, owing to the particles becoming buried in the tissues.

Miller recommends precipitated chalk, taken up on the tooth-brush with a dash of neutral or slightly alkaline soap, but he also considers a tooth-soap as being preferable to tooth-powder. He has also pointed out that as a matter of fact there is no evidence whatever that anything has as yet been accomplished in the prophylactic mouth wash alone: " It would, however, be going too far if we were to adopt the views " of those who have expressed the opinion that by proper care of the " teeth and consistent use of antiseptic washes from childhood on, decay " would be entirely banished from the human mouth. This view is too " optimistic, for various reasons, chiefly because there are places in " every denture which will remain completely untouched even by the " most thorough application of the antiseptic which will reach them in " so diluted a condition that it possesses little or no action. If a very " thorough mechanical cleansing has not preceded the antiseptic, its " action upon the centres of decay will be equal to little more than " zero. The great difficulty lies further in the fact that nearly all the " materials which possess antiseptic action are either contra-indicated " altogether in the mouth, or that they may be used only in very dilute " solutions, either because they are injurious to the general health, or " locally to the mucous membrane or to the teeth themselves. Finally, " many otherwise useful antiseptics are excluded because of their bad " taste and smell. For these reasons the preparation of a mouth wash " which possesses antiseptic action of any importance is accompanied " by the greatest difficulties."

Miller has made an interesting series of experiments in order to determine the time necessary for devitalisation with a number of the antiseptic materials in the form of a mouth wash. As the time during which in rinsing the mouth the wash remains in contact with the teeth varies from a few seconds to at most a minute, it will at once be seen that in order to sterilise the oral cavity a material must be found which is capable of devitalising bacteria within a minute or less. It is possible after the complete mechanical cleansing of the mouth to obtain by means of a solution of bi-chloride of mercury (1 in 2,500), the almost perfect sterilisation of the mouth. On account of its poisonous properties and still more, perhaps, from its horrid and undisguisable taste, this material is not suitable for general application.

Listerine which consists of oil of eucalyptus, borobenzoic acid, winter green oil, &c., has been proved experimentally to be a very useful antiseptic mouth wash. It should be applied on a brush on cleansing the teeth or slightly diluted as a mouth wash.

The best means, then, we have towards attaining this seeming impossibility of having a scientifically clean mouth is to rely on a very thorough application of mechanical means tooth-brush, floss silk, &c., aided by antacid and sterilising washes, the efficacy of which will be in proportion to the time of contact.

The hygiene of the sick-room has been excellently treated except on the question of defective personal hygiene as it affects the mouth, and as the subject is not mentioned as far as I know in any published work on the care of the sick, nor even in any popular treatise on the teeth, a few words here may not be out of place.

Dr. Briggs, of Boston, has published some valuable hints and directions on this subject, and rightly emphasises it with a view to the comfort of the invalid: "If you wish to see a grateful patient, rinse the " mouth with some antiseptic solution, after he has been left for days " without care! I have had people tell me that nothing done for them in " the course of their illness gave them such a feeling of [illegible] and rest " as purifying the mouth.

" In extreme cases [illegible] the patient is in a comatose condition, the " mouth can be wiped out with a soft cloth wet in the antiseptic solution; " but in most cases I have found the ordinary invalid feeding-cup to " answer the purpose nicely. The patient takes the solution into the " mouth through the long spout, and, having rinsed thoroughly, closes the " lips about the spout and forces the liquid back into the cup, all done " without raising the head from the pillow.

" I have no doubt there are physicians and nurses who attend to " this matter, but I also doubt not that they are few and far between."

The proper time for the principal act of this personal hygiene is after the last meal. To brush the teeth in the morning only, is to lock the stable door after the steed is stolen. To do so after each meal must obviously be salutary and so economic a proceeding, that the time necessarily involved is far from being wasted. To those who have never acquired the habit, it may seem irksome and unnecessary, but to those

who have done so, comfort is not complete without even these supplementary cleansings.

Shortly after taking my degree at Harvard University, in 1876, I was called upon to act as dental officer for a short period, in a school devoted to the training of some poor gutter children, near Boston, U.S.A., and never shall I forget my first visit to that school, and seeing the children turn out promptly after dinner to what we may term their usual tooth-brush parade. In that school they needed not my instruction, but only my professional services in repairing the small amount of caries, inevitable even amongst such well cared for mouths. My fee was paid out of the private contributions of the members of the committee, a highly intelligent body of men and women, who showed the appreciation of the services of their own family dentist in the best possible way, by caring for, and treating the teeth of those poor children as if they belonged to members of their own family. Nor could I help contrasting this state of affairs with the miserable treatment I myself received when at school. In our dormitories there hung at the end of each bed, a bag for the reception of the brush and comb and I well remember on its external aspect a long mysterious narrow pocket, evidently intended for the reception of the tooth-brush handle. During my residence of seven years in that school, I never saw within the walls of the institution a tooth-brush in one of these pockets, yet it was a rich institution, in fact so rich that it really did not know how best to spend its income. There was a dentist attached to the school, but my own experience, like that of the other boys, was ruthless extraction of our teeth when they ached. I have since learned that he received the munificent sum of 10*l.* a year for his services in a school of 180 boys, and I further know now that this skilled and scientific practitioner delegated his functions to the none too delicate hands of his pupils with a view to giving them practice. No attempt to prevent pain and suffering and the loss of valuable organs by filling, no advice as to cleansing or caring for them, came within our ken. Better for me, at least, better for my dental armature, had I been one of those gutter children at that American School than the successful scholar in that rich Foundation School. Better the intelligent care of that considerate lay committee than the ruthless indifference of that highly qualified school dentist.

If I have seemed to dwell unduly on this question of oral hygiene, it is for a very simple reason. The economic aspect of any proposed measure of reform must always demand careful consideration, but it would be impossible for any body of school managers to assert with reason that any reform of school dental hygiene presents any serious economic difficulty. While the initiation of any reform rests with the authorities, it is the superintendents and the teachers who must be the active agents in its application. Teachers in schools where the children are resident cannot escape from their vicarious parental responsibility. They may, like parents, descant on the alleged impossibility of getting children to brush their teeth, forgetting that the regular cleansing of the mouth is as teachable as the washing of the face.

In the schools examined on behalf of the British Dental Association the mouths of all the scholars were certified as clean in one school only, the Church of England Home for Waifs and Strays, Marylebone Road. Here the excellent tooth-brush habits are encouraged by a system of good marks which is sufficient proof that the result is due to a difference in the authorities rather than in the scholars.

One good and direct effect of our collective investigation has been the introduction of a tooth-brush into some of the schools examined. That the mere supply of a tooth-brush is insufficient, is proved by the return from a small better-class school in Cambridge where the boys resided with their parents or guardians and in every case acknowledged their possession of a tooth-brush. Not a single mouth could be registered as clean, all dirty and a few very dirty. Inquiries as to when they used it elicited such replies as "on Sundays," "twice a week," "occasionally," "when I go out to tea," &c.

We must now consider as briefly as possible the necessity for remedial treatment for this disease which is so characteristic of all the periods of school life from infancy onwards.

As the temporary teeth have already been alluded to, let us consider the principal features of the British Dental Association investigation.

A very small per-centage of children have mouths free from caries, and a still smaller per-centage do not require dental treatment of any kind. In a large number of cases the cavities are few and in such a condition that a short and almost painless operation would save the teeth for years and in some cases for life, were proper hygienic care bestowed upon them. Indeed such teeth, where the decay had been removed and the cavity filled, would actually be in a better condition than when erupted, as all such early carious cavities are dependent upon structural defects such as pits and grooves in the enamel. This latter fact is further illustrated by the tendency of the corresponding teeth on each side of the mouth which are developed at the same time, to become carious. Despite these defects, such teeth may have a high co-efficient of resistance.

In another series of cases we may find many cavities, but still in an initial stage, in which, besides the pits and fissures, we find the approximal surfaces attacked, mainly in front teeth. In yet another series, we find that, from the rapid development of caries, a few teeth are already too far gone for any treatment, otherwise than by extraction, such a condition may be found even within a few months after eruption. Still these cases are only advanced stages of cavities, which were once in the incipient stage, and therefore once saveable.

In a very small per-centage of cases we find a large number of cavities in an advanced stage. In such cases any remedial treatment will have to be renewed again and again, as no process of filling can affect the low co-efficient of resistance, though diet, out-door exercise, and use of the teeth may improve their quality as age advances.

In quite a number of cases the labial surfaces of the teeth are found to be seriously affected, not so much by cavities as by surfaces of

decay extending over the enamel, such a condition is entirely owing to habitual uncleanliness, as the teeth are often covered with a thick coating of a pasty starchy mass of food débris. If the decay has not extended beyond the enamel, thorough cleansing and polishing of the enamel may arrest the mischief.

The tooth most frequently affected with caries is the first molar which is erupted during the fifth, sixth, or seventh year. The first permanent or so-called sixth year molars are the largest teeth in the mouth and therefore very important factors in mastication. They have no successors and should not be allowed to become extensively decayed; even if they cannot be permanently saved, there are good reasons, with reference to the preservation of the integrity of the arch and to the requisite growth of the jaws, why they should be retained until the second molars (twelth year) are erupted or erupting.

The economic aspect of treatment at this age is of the highest importance, for caries is essentially a disease of youth, from its dependence on predisposing causes which diminish as age advances. Most weak points in structure, pits, depressions, and proximal surfaces, will have been attacked before the age of 17 or 18, and almost all those which will ever succumb by the age of 25 years. Further, a cavity of decay in the proximal surface of one tooth usually leads to its neighbour becoming affected, and thus far caries is an infectious disease. Even in bad cases, if the caries can be eradicated and excluded for a time, its control becomes fairly easy if the patient performs rigorously his share of the preventive work.

It is also true that if certain teeth must be extracted, the best time for doing so is between the eleventh and the thirteenth year.

Treatment during school life directed to the amelioration of any irregularity of the teeth must be an important factor in minimising the number of carious cavities by the removal of a not infrequent predisposing cause. Moreover in many cases where the position of the teeth is quite regular, it is found that the extraction of four teeth, most frequently the first molars, or more rarely either of the bicuspids, is in its final effect more truly conservative treatment than their retention by resort to purely restorative operations.

The greater the likelihood of the individual being unable to procure the alternative restorative treatment in later life, the greater is the necessity for applying this remedial radical treatment, technically termed symmetrical extraction. This operation to be most successful should be performed from the eleventh to the thirteenth year, according to the eruption of the teeth. If it is deferred to a later age than the fifteenth or sixteenth year there is great uncertainty as to the final results. The subsequent movement of the teeth which results from judiciously applied symmetrical extraction is such that even an expert may doubt in later years, as to whether the first molars have been extracted or not, whereas the functional value of the denture as a masticating organ may be ruined by the indiscriminate extraction of the same number of teeth.

To ignore the abnormal or diseased conditions of the teeth during this period (from the sixth to the sixteenth year), even if unaccompanied by pain, will inevitably lead to a partial, if not a complete, wreckage of the dental organism as a masticatory apparatus, earlier or later, in the third period of the individual's life history. There can be no question that from the trifling attention, and often from the entire lack of attention, paid to the teeth during this important period of eruption, a very large number of patients are doomed to pass through the third and major portion of their lives lamed and crippled so far as their jaws are concerned, or obliged to put up with the relatively poor comfort, and frequent discomfort, of artificial substitutes. The lack of the watchful care of a thoroughly qualified dental practitioner, especially during the first half of the eruptive period, frequently entails resort to the cumbersome, the discomforting, and the expensive mechanical appliances for the correction of irregularities which might have been easily avoided.

During the past ten years I have had an opportunity of acquiring a pretty thorough knowledge of the average condition of the teeth of the University undergraduate, and have seen the fearful destruction caused by dental caries in the mouths of those who may be taken as typical of all that is best so far as social condition, physique, and means can afford mitigation or relief of these conditions.

If we regard for a moment even the purely academic aspect of some of these cases, is it not a deplorable short-sightedness and a sense of false economy, which leads both the parent and the schoolmaster, by the neglect of attention to the dental organism during this eruptive period, to run the risk of a complete breakdown of the student on the eve of an all-important examination from pain and suffering with his teeth? The period of the ordinary, and especially of the honours or the tripos examinations at Cambridge, is characterised by a notable increase in the number of acute cases calling for treatment, and I have known more than one case where the student's position in the class list was materially affected thereby. What is true of this class of the community must be also more or less true of others. An intelligent student somewhat surprised me the other day by asking why it was that the parent and schoolmaster were generally so particular as to the quality and sufficiency of the food at school and so utterly disregardful as to whether the boys had or had not an efficient dental mechanism for the mastication of that food. Of course, my only reply could be that it was in consequence of their utter ignorance of the importance and the advantages, both economic, and, as I am also convinced, educational, derivable from adequate attention to the teeth of the school children.

Without dwelling on the prevalent neglect of the teeth during early life, and the great amount of severe pain, loss of teeth, and the consequent incapacity for complete mastication—entailing indigestion and other serious maladies—to which that neglect leads, I should like to refer to the evidence of Mr. Bennett Williams, who has called attention to a fact which cannot be without interest in such a Section as this, namely, that a defective condition of the teeth may seriously impair their function as a part of the mechanism of phonation.

As a contrast to this, I would quote the evidence of a distinguished tutor at Trinity College, Cambridge. He advises his pupils to have their teeth put thoroughly in order, as he has found so many of them break down at examination time from acute pain. These cases are always of the third or fourth degree of caries and therefore of long standing, and involving disease of the pulp or the pericementum.

In the course of tabulating the British Dental Association statistics I was prompted to place the returns of teeth filled amongst the "accidents," for the very simple reason that I had before me the condition of about 2,000 mouths and only two teeth returned as having been filled. Out of about 40 schools examined, I found only one to which a dentist had been appointed and was compensated in such a manner that his professional service was not confined to merely extracting teeth. This school is the Metropolitan and City Police Orphanage at Twickenham. A careful perusal of the report of the board of managers of the year 1890, shows that this institution is very largely supported by the contributions of the various police divisions. The dental surgeon's report is instructive, and the result of the statistical inquiry for the association is a very satisfactory proof of the utility of qualified professional skill. Under all the heads of inquiry this school contrasts very favourably with the others. In fact, it headed the list of having the lowest number of teeth requiring attention, as related to sex and average age. The number of boys examined was too small for comparison with other schools. The number of girls (84) is sufficient to give average results. The lowest age was eight and the highest age was 15, and the average age 12 years and 8½ months. The number of temporary teeth requiring filling was eight, and the number requiring extraction was 31. The number of permanent teeth requiring filling was 31, and the number of teeth lost was 19, and the number of teeth demanding extraction was 49. The number of teeth filled was 67, a figure which is quite unique in our investigation so far. In estimating the number of teeth which had been attacked with caries it was necessary to correct the total of teeth requiring attention, and the ratio was thus raised from 118 per cent. requiring attention to 197 originally defective, thus showing that 80 per cent. had received adequate attention. The dental surgeon attached to this school may well be proud of this achievement, as it represents an expenditure of professional time for, which in my opinion, he is only partially remunerated by his annual salary of 20*l.*

The managers of the North Surrey District School at Anerley, appointed a qualified dental surgeon some years ago. The dental surgeon attends one morning in each week, the school directors supplying instruments and materials and giving a salary of 60*l.* a year. As there are 850 boys and girls between the ages of 3 and 16, I believe the remuneration is insufficient if the work be efficiently performed.

In a few other schools, appointments have been made with satisfactory results, except where the amount of remuneration is so inadequate that only extractions are done.

It is not creditable to the humanity of the age in which we live that even the poorest children should continue to be subjected to a cruel operation which it is perfectly evident might be avoided in a very large proportion of cases.

The following report in connexion with the Dundee Industrial School, containing 200 boys and 85 girls, from Mr. Fisher's case book, is more to the point. These are the words of the report: "Toothache "seems the great, and almost the only, trouble in the schools. The "housekeeper said that if they had a dentist they could dispense with "the services of the physician; as yet they have no dental attention "beyond an occasional extraction when a child is suffering from acute "pain." Mr. Fisher has also shown the economic aspect of this question, especially as related to industrial schools, by showing that to continue neglecting the teeth of these children—when they are at the age that the maximum of benefit may be attained with the minimum of work—seems to be something like our Legislature continuing a vice against itself, as the very boys the Home Office endeavours so well to develop physically strong, and on whom the Treasury spends so much, are ignored by the Admiralty if they have the misfortune to be in the possession of a few bad teeth, when it is scarcely possible for it to be otherwise, as they do not receive the requisite attention and treatment to sustain their physical life.

With regard to the better-class schools, and especially those where the pupils are not resident, I would suggest the appointment of a dental officer, not necessarily to supply professional services to the pupils, unless the parents had failed to have the teeth attended to by their own dentist. Nothing should be done to interfere with the rights of the parents to consult the dental practitioner in whom they have most confidence.

An alternative plan, which is already adopted by some, in this respect, intelligent schools, is that a certificate from some reputable practitioner that the teeth are in good order should be required on entering the school, and also on the return from each vacation. Autocratic as such a suggestion may sound, it is justifiable, for our contention is that just as children suffering from other diseases are declined until restored to health, so those suffering from dental disease should be refused as unfit for scholastic work.

Wednesday, 12th August 1891.

The Chair was successively occupied by—
THE PRESIDENT,
DR. A. JACOBI,
DR. GLADSTONE,
DR. WM. BROWN.

The following Resolution, submitted to the Section by the School Board of Hull, was read, and ordered to be entered on the Minutes:—

> "That this Board is strongly of opinion that while the sanitation of public elementary schools has been much improved under State regulations, a large number of private adventure schools exist which are gravely deficient in sanitary arrangements, and are subject to no proper sanitary inspection whatever; and that steps should be taken by the Congress to impress upon the Government the necessity of placing these schools under some efficient system of inspection."

The Working Curve of an Hour: an Experiment concerning Overpressure of Brain.

BY

Dr. LEO BURGERSTEIN, Vienna.

It is not difficult to observe that one hour's occupation with the same subject produces fatigue in school-children; certainly we are not able to indicate a special reason why school lessons for the different subjects and ages last just one hour. If there must be a generally fixed period for school lessons, it is to be wished that this period be only so long as the *most difficult* subject taught to the *youngest* children may permit.

As for the somatic question, we know for example very well how great the pollution of air in schoolrooms generally is, and so on; greater difficulties arise from the psycho-physiological question; as to that, we have not the needed direct examinations.

It was for that reason I made the following experiment. I wrote the 10 figures of our decadic system in quite an arbitrary manner, and then continuing a second time in a new arbitrary combination; below those 20 figures I wrote a new combination of 10 and 10 figures, and so the first addition example was given.

Combinations of that kind were made 10 times, always varying the series; so I had 10 addition examples of the same working value and the needed variation in the detail. Second 10 addition examples were

found by writing the second, fourth, sixth, and then the first, third, fifth pair of figures from the first 10 examples. The third 10 addition examples I obtained by writing the examples for the first 10 additions backwards, the fourth 10 by writing the second 10 examples backwards.

So I had four times 10 addition examples of the same working value and variety in the detail.

Then I wrote the first line of every addition as multiplicand, and took the figures 2, 3, 4, 5, 6, 2, 3, 4, 5, 6 as multiplicators; so I had four times 10 multiplication examples of about the same working value.

Now I took the first addition as number 1, the first multiplication as number 2, the second addition as number 3, and so on. In that way I arranged the first 10 addition and 10 multiplication examples as work for the first 10 minutes of a school lesson; and in a similar manner 20 examples, 10 additions and 10 multiplications for a second, third, and fourth 10 minutes' time. The examples for every ten minutes were printed in a convenient form, with figures of 4 m.m. high.

Here I give a copy of the task set for the first 10 minutes and the first example of the second, third and fourth 10 minutes' task:—

I. Name: Class:

Nr. 1) Add -	2 8 7 0 3 4 5 1 6 9 2 7 4 0 8 3 1 5 6 9
	+ 3 5 8 6 9 4 2 7 1 0 8 2 1 5 9 7 6 0 4 3
Nr. 2) Multiply	2 8 7 0 3 4 5 1 6 9 2 7 4 0 8 3 1 5 6 9 × 2
Nr. 3) Add -	5 4 3 9 2 8 0 6 7 1 5 7 8 9 3 0 6 2 1 4
	+ 6 2 5 9 1 3 4 0 7 8 8 1 0 6 2 7 8 4 9 3
Nr. 4) Multiply	5 4 3 9 2 8 0 6 7 1 5 7 8 9 3 0 6 2 1 4 × 3
Nr. 5) Add -	7 2 6 8 0 5 1 9 4 3 3 7 6 0 5 1 4 2 9 8
	+ 4 6 7 1 3 5 0 2 9 8 1 6 9 2 4 3 0 7 5 8
Nr. 6) Multiply	7 2 6 8 0 5 1 9 4 3 3 7 6 0 5 1 4 2 9 8 × 4
Nr. 7) Add -	6 4 3 0 8 5 2 9 1 7 8 9 7 2 0 5 3 6 4 1
	+ 2 5 6 8 4 3 9 7 1 0 2 1 5 0 9 7 3 8 6 4
Nr. 8) Multiply	6 4 3 0 8 5 2 9 1 7 8 9 7 2 0 5 3 6 4 1 × 5
Nr. 9) Add -	3 8 9 2 7 5 6 0 1 4 1 5 7 9 3 2 4 0 6 8
	+ 4 6 8 2 9 1 3 0 5 7 2 9 3 4 0 5 8 1 6 7
Nr. 10) Multiply	3 8 9 2 7 5 6 0 1 4 1 5 7 9 3 2 4 0 6 8 × 6

Nr. 11) Add - 5 7 2 8 9 1 0 4 3 6 2 0 9 8 1 3 5 6 7 4
+ 7 0 4 8 3 5 6 9 2 1 1 4 8 2 0 3 9 5 6 7

Nr. 12) Multiply 5 7 2 8 9 1 0 4 3 6 2 0 9 8 1 3 5 6 7 4 × 2

Nr. 13) Add - 9 1 0 2 7 8 3 5 4 6 2 9 8 6 5 4 0 7 1 3
+ 6 9 7 0 4 3 1 5 2 8 8 0 1 3 6 4 9 2 7 5

Nr. 14) Multiply 9 1 0 2 7 8 3 5 4 6 2 9 8 6 5 4 0 7 1 3 × 3

Nr. 15) Add - 5 6 2 1 0 9 7 4 3 8 7 3 5 6 8 0 2 9 4 1
+ 3 6 9 4 5 2 8 1 0 7 5 6 4 7 9 0 3 1 8 2

Nr. 16) Multiply 5 6 2 1 0 9 7 4 3 8 7 3 5 6 8 0 2 9 4 1 × 4

Nr. 17) Add - 8 1 2 0 3 7 5 6 9 4 3 0 8 5 9 7 6 4 1 2
+ 5 6 7 3 8 1 2 4 9 0 9 8 4 0 7 3 2 5 1 6

Nr. 18) Multiply 8 1 2 0 3 7 5 6 9 4 3 0 8 5 9 7 6 4 1 2 × 5

Nr. 19) Add - 2 3 7 5 0 1 6 9 4 8 1 9 2 0 8 6 5 7 3 4
+ 2 4 7 8 1 3 9 5 6 0 8 4 5 2 6 0 1 9 7 3

Nr. 20) Multiply 2 3 7 5 0 1 6 9 4 8 1 9 2 0 8 6 5 7 3 4 × 6

II. Name: Class:

Nr. 1) Add - 8 0 4 1 9 7 0 3 5 9 2 7 3 5 6 2 4 8 1 6
+ 5 6 4 7 0 2 5 7 0 3 3 8 9 2 1 8 1 9 6 4

III. Name Class:

Nr. 1) Add - 9 6 5 1 3 8 0 4 7 2 9 6 1 5 4 3 0 7 8 2
+ 3 4 0 6 7 9 5 1 2 8 0 1 7 2 4 9 6 8 5 3

IV. Name: Class:

Nr. 1) Add - 6 1 8 4 2 6 5 3 7 2 9 5 3 0 7 9 1 4 0 8
+ 4 6 9 1 8 1 2 9 8 3 3 0 7 5 2 0 7 4 6 5

The work required here was very light, the children being accustomed a great many times to make additions and multiplications, and there was a pause of five minutes after every ten minutes' work. The

work was done chiefly during the first school lesson in the morning. Of course it would be of use to make many other experiments also.

School and Class.		Day of the Experiment.	School-Lesson in the Morning.	Number of Children (162 in all).	Average Age, Years, Months, Days.
					Y. M. D.
Public School for *Girls.* ("Bürgerschule.")	Fourth	Monday	The first, 8-9 o'clock.	35	11 0 2
	Fifth	Monday	The first, 8-9 o'clock.	33	11 10 5
(Commercial) School for *Boys.* ("Real schule.")	First	Tuesday	The first, 8-9 o'clock.	44	12 2 10
	Second	Monday	The second, 9-10 o'clock. (8-9 French language.)	50	13 1 0

The total number of figures made by all the 162 individuals in the 40 minutes was as follows:—

Resulting Figures.			Errors.			Corrections.		
Total.	Addition.	Multiplication.	Total.	Addition.	Multiplication.	Total.	Addition.	Multiplication.
135,010	70,473	64,537	6,504	2,255	4,249	2,649	1,132	1,517

Three second-class boys were ready with the third 10-minutes work together, in 2½ minutes before 10 minutes were over; 7 second-class boys furnished the work for the fourth 10-minutes' time together, 10 minutes before the 50 times 10 minutes. For all those individuals I made an alteration in the form of an augmentation of their respective number of figures, errors, and corrections, calculated in their respective 10 minutes; with those alterations the number of figures, &c., is severally as follows:—

Resulting Figures.			Errors.			Corrections.		
Total.	Addition.	Multiplication.	Totals.	Addition.	Multiplication.	Total.	Addition.	Multiplication.
135,637	70,787	64,850	6,514	2,259	4,255	2,658	1,135	1,523

We see that my alteration of the numbers has no essential effect upon the general result. I shall consider, in the following remarks, the results obtained from using the altered numbers.

In seeking the wrong ways taken by the minds of children, one may observe in a great many cases, that a figure which has been often named (written thought) just before exercises an influence; remainders are forgotten to be carried on, or remainders not existing are carried on; that operations are changed, figures of a similar form are confused, or

without visible reason figures are mistaken. It is not possible to furnish statistics based on the different qualities of errors, because the origin of a great many is not clear. Many observations show *a diminished aptitude to keep in the mind things done just before;* other errors indicate *a depression of the faculty of perception*, as does the changing of the figures.

As to the explanation of errors, one may observe in the school itself, when children are counting aloud, that there are mistakes, for the origin of which a special reason is not to be found.

Often, of course, there are series of mistakes, because it is not possible to know exactly how many times a false figure in such a series is the natural consequence of another wrong one. I counted every wrong figure as a unit. My idea was the comparison of the quality of work in the consecutive 10-minutes' periods. Corrections signify foregoing errors, but they signify also a perception of the error at the right time. I think then, that a greater number of corrections may signify rather a better than a lower standard of work, even if there are more errors at the same time.

As a consequence of practice, it is to be expected that *the work performed should increase in every consecutive period*, so long as the organic material is sufficient. The performance itself is composed here of both quantity and quality; but I think that one would not expect in advance the results which appear from the experiment.

The results show, first of all, in the average of every class an increase as well of the resulting figures as of the mistakes and corrections. If the number of mistakes increases in a higher degree than that of figures, the difficult question arises, whether with the increase of *quantity* and the decrease of *quality* of the work, the total of *performance* is a better, equal, or lower one.

The per-centage of the resulting figures, errors, and corrections from the first working period to those following is, for all the children collectively, as follows:—

The Figures, Errors, Corrections increase	Figures.	Errors.	Corrections.
From the I. ten-minutes' time to the II. of % made in the I.	14·8	51·5	58·2
" " " " III. " "	25·3	136·3	162·8
" " " " IV. " "	39·5	177·3	194·0

that is to say, the increase of mistakes is much higher than that of resulting figures.

For all individuals together, the number of figures, mistakes, and corrections, is as follows:—

The number of *resulting figures* for all individuals together *increases*—

From the I. ten minutes to the II. in the amount of 4,210 figures.
" II. " " III. " " 2,966 "
" III. " " IV. " " 4,007 "

that is to say 4, 3, 4 thousands; from the II. to the III. 10-minutes' time the absolute *increase of quantity of work* is the *lowest* one.

The number of *errors increases*—

from the	I.	ten-minutes'	time	to the	II.	by the	amount of	441	errors.
„	II.	„	„	„	III.	„	„	719	„
„	III.	„	„	„	IV.	„	„	349	„

that is to say, about $4\frac{1}{2}$, 7, $3\frac{1}{2}$ hundreds; from the II. to the III. ten-minutes' time the *diminution* of the *quality* of work is the *greatest* one.

The number of corrections increases—

From the	I.	to the	II.	ten-minutes'	time	by the	amount of	207	corrections
„	II.	„	III.	„	„	„		166	„
„	III.	„	IV.	„	„	„		225	„

that is to say, about 2, $1\frac{3}{4}$, $2\frac{1}{4}$ hundreds; from the II. to the III. ten-minutes' time the increase of corrections is the smallest one; from the II. to the III. ten-minutes' time the increase of mistakes is the greatest one, the opportunity of making corrections then very great; on the other hand, the augmentation of figures is the smallest one. As to the corrections, I do not lay much stress upon them.

If we count how many errors are contained in every hundred resulting figures, we find, that in the—

I.	ten-minutes'	time	there are	3·010	per cent.	of errors,	or about	3
II.	„	„	„	3·978	„	„	„	4
III.	„	„	„	5·673	„	„	„	5·7
IV.	„	„	„	5·982	„	„	„	6

that is to say, the mistakes are springing up most in the III. ten minutes' time; the subsequent diminution of the quality of work in the IV. ten-minutes' time is very small in comparison, about one-sixth of that made in the III. ten-minutes' time.

It follows, then, that in the III. ten-minutes' time, at this stage of a child's development, the faculty of occupying himself seriously with a subject, already treated for half an hour before, is remarkably diminished, the organic material being in a high degree exhausted; it seems as if in a certain moment of the III. ten-minutes' time a relaxation of the mental intensity takes place, as if the children *unconsciously must repose;* the fact itself recalls an observation, which beginners especially can make with bodily exercise, that after some time of exertion a lassitude appears, and working farther, the sensation of weariness passes away. I do not know whether these facts are really comparable, and if so, whether it is to be wished that undeveloped children should pass through this state of weariness several times a day through many days in a series of years.

To make a similar comparison for each class would be of no great value; but the age and sex of the individuals, and the number of school-years they have passed through being different, and the whole number of them not being great—although as great as I could get it—it is of importance to see whether the general result given above is found to be confirmed by the small number represented by each class.

The following table gives the differences of figures, mistakes, and corrections between the ten-minutes' times in every class. I have marked by italics the facts supporting the general result.

Classes, Number of Individuals, and average Age.	Differences between the following ten-minutes' times.	Resulting Figures in the whole.	Resulting additional Figures.	Resulting Multiplication Figures.	Errors in the whole.	Addition errors.	Multiplication errors.	Corrections in the whole.	Addition corrections.	Multiplication corrections.
4th Girl class; 35 individuals; 11 years.	I.-II.	36	27	9	*93*	18	*80*	*42*	*25*	17
	II.-III.	*603*	*312*	*291*	*242*	36	*206*	*6*	*—11*	17
	III.-IV.	*873*	*505*	*368*	*189*	88	*41*	*34*	*21*	13
5th Girl class; 33 individuals; about 12 years.	I.-II.	*593*	*271*	*322*	*183*	*30*	*153*	*32*	2	*31*
	II.-III.	*293*	*93*	*200*	*258*	*105*	*153*	*25*	26	*— 1*
	III.-IV.	*672*	*431*	*241*	*111*	*35*	*76*	*36* *	16	*20*
1st Boy class; 44 individuals; about 12 years.	I.-II.	1,160	463	697	*68*	22	*46*	*65*	16	*49*
	II.-III.	938	536	402	*96*	14	*82*	*25*	17	*8*
	III.-IV.	28	71	—43	*5*	24	*—19*	*28*	5	*23*
2nd Boy class; 50 individuals; about 13 years.	I.-II.	*2,421*	*1,147*	*1,274*	*92*	47	*45*	67	40	27
	II.-III.	*1,130*	*598*	*532*	*123*	18	*105*	*110*	*41*	69
	III.-IV.	*2,434*	*1,262*	*1,177*	*104*	39	*65*	*120*	*71*	49
All four classes together; 162 individuals.	I.-II.	4,210	1,908	*2,302*	*441*	137	*304*	*207*	*83*	*124*
	II.-III.	*2,966*	*1,341*	*1,425*	*719*	173	*546*	*166*	*73*	*93*
	III.-IV.	4,007	*2,269*	*1,738*	*349*	186	*163*	*225*	*116*	*109*

* A — before a number signifies that in the respective ten-minutes' time so many less figures (errors, corrections) have been made than in the foregoing ten-minutes' time.

On the whole, the table supports the general rule; where the augmentation of figures or corrections from the II. to the III. ten-minutes' time is lower, and that of faults is greater, than from the III. to the IV., the last two lines of each triple set of figures in the vertical column are printed in italics; where all three lines are printed in italics it signifies that the augmentation of figures (or corrections) is the smallest from the II. to the III. ten-minutes' time, smaller not only than from the III. to the IV., but also than from the I. to the II. ten-minutes' time; where all three lines in an "Error" column are printed in italics, it signifies that the greatest augmentation occurred from the II. to the III. ten-minutes' time. A minus sign signifies that the difference is a negative one.

In all cases the augmentation of faults in general, and of multiplication faults especially, is the greatest from the II. to the III. ten-minutes' time.

The most singular class is the first of the boy-classes, that is to say, the first class of the "Realschule" with respect to the figures counted, the increase going always down. I cannot find for this a quite sufficient explanation; but it is a matter of fact, that, differently from the other classes, those children form a very mingled society in their class itself, some coming from different public schools, with a different number of school years gone through before, others with private preparation of different length and intensity. I must remind you also, that only in that class was the experiment made on a Tuesday (in the other three on a Monday), and that the day before there had been four lessons in the forenoon and two in the afternoon.

The next table shows in detail, how many errors and corrections are made in every hundred resulting figures; it is seen also here—I have marked the characteristic numbers in *italics*—that the greater part (two-thirds) of the results support the general rule, though the number of individuals used as a basis is a very small one in the single classes.

Classes.	Ten Minutes' Times.	Errors in the whole.	Addition Errors.	Multiplication Errors.	Corrections in the whole.	Addition Corrections.	Multiplication Corrections.
4th Girl Class.	I.	*6·225*	4·722	*7·926*	*1·464*	*1·053*	1·930
	II.	*8·058*	5·323	*11·170*	*2·258*	*1·942*	2·618
	III.	*11·378*	5·950	*17·813*	*2·128*	*1·890*	2·961
	IV.	*11·620*	7·561	*16·757*	*2·358*	*1·779*	3·629
5th Girl Class.	I.	*4·706*	*2·892*	*6·764*	*1·982*	1·624	*2·866*
	II.	*7·131*	*4·187*	*10·407*	*2·314*	1·553	*3·481*
	III.	*10·674*	*7·086*	*14·479*	*2·586*	2·265	*2·926*
	IV.	*11·207*	*7·201*	*15·658*	*2·839*	2·426	*3·297*
1st Boy Class.	I.	*1·496*	1·334	*1·690*	*1·174*	1·091	*1·470*
	II.	*2·065*	1·679	*2·473*	*1·750*	1·330	*2·496*
	III.	*2·843*	1·777	*3·997*	*1·837*	1·523	*2·178*
	IV.	*2·885*	2·215	*3·628*	*2·116*	1·598	*2·689*
2nd Boy Class.	I.	*1·488*	1·105	*1·845*	0·923	*0·642*	1·230
	II.	*1·933*	1·665	*2·214*	1·297	*1·175*	1·424
	III.	*2·706*	1·785	*3·680*	2·026	*1·068*	2·391
	IV.	*2·982*	1·990	*3·971*	2·526	*2·342*	2·722
All four Classes together.	I.	*3·010*	*2·203*	*3·913*	*1·308*	*1·045*	1·604
	II.	*3·978*	*2·767*	*5·280*	*1·776*	*1·419*	2·160
	III.	*5·673*	*3·477*	*8·089*	*2·096*	*1·697*	2·525
	IV.	*5·982*	*3·996*	*8·163*	*2·453*	*2·073*	2·871

I have calculated also the average result per individual in each class; since the results are furnished by the different classes, and the same ten minutes' time always produces a similar result in each class, I give here only the general result for all individuals:—

Ten Minutes' Times.	Figures in the whole.	Addition Figures.	Multiplication Ciphers.	Errors in the whole.	Addition Errors.	Multiplication Errors.	Corrections in the whole.	Addition Corrections.	Multiplication Corrections.
I.	*174·48*	*92·14*	*82·33*	*5·25*	2·03	*3·22*	*2·28*	*0·96*	*1·32*
II.	*200·47*	*103·92*	*96·54*	*7·97*	2·87	*5·09*	*3·36*	*1·47*	*2·08*
III.	*218·78*	*113·43*	*105·34*	*12·41*	3·94	*8·46*	*4·58*	*1·92*	*2·66*
IV.	*243·31*	*127·44*	*116·07*	*14·36*	5·09	*9·47*	*5·97*	*2·64*	*3·33*

As to the character of the writing, I could not find out which sheet of paper was used in the various periods if I mixed the four sheets of one individual.

I think it seems that the power of working rises and falls during the time of the ordinary lesson, so that it would be of use to study the question more closely.

It is a known matter of fact that well-developed healthy children are, if not sleeping, always active, both mentally and bodily; but it

is also a matter of fact that they are generally at short intervals changing their occupations, that they have a great need of bodily movement, not only of a mental one; and so on. The pedagogic desire to approach them to the ideal normality—to accustom them to a continuous occupation with one subject—is a very difficult task; and it seems to me that it is not proper to demand that the beginners should have lessons of one hour—like the elder ones—and without bodily movement between the lessons. It is possible, however, with the greater number of children to train them quickly enough so far as not to "disturb" the class, but it is a matter of fact also that a great part of the whole class does not always follow the mental exercise which the teacher undertakes, though they are "quiet." That is, on the one hand, not the right way to a healthy condition of school life; and on the other hand, it is a dangerous principle, as they are plainly taught in this way to deceive the teacher. It seems then, best not to let lessons last longer than three-quarters of an hour; and to interrupt the continuation of lessons by pauses of about a quarter of an hour so as to have the children's brain rested, the body moved, and the schoolroom air changed.

I propose the following Resolutions:—

1st. *It is desirable that the question of mental overpressure should be studied by exact experimental methods, and that school authorities should instigate experiments in that direction.*

2nd. *Until the question of overpressure has been thoroughly investigated by scientific methods, no school lesson should last longer than three-quarters of an hour, followed by a quarter of an hour's rest.*

1. *Es ist wünschenswert dass die Frage der geistigen Überbürdung auf exacte Weise durch experimentelle Untersuchungen studiert werde und dass die Schulbehörden Experimente in dieser Richtung fördern mögen.*

2. *Ehe die Überbürdungsfrage nicht ausreichend in einer modernen wissenschaftlichen Weise studiert ist, sollen die einzelnen Schullectionen im allgemeinen nicht länger als drei Viertelstunden dauern unterbrochen durch viertelstunden Pausen.*

L'Hygiène Scolaire en Belgique.

PAR

le Dr. Prof. Hyac. Kuborn, de Seraing, Liége.

Vieilles maisons plus ou moins appropriées; locaux mal éclairés, mal aérés; absence de préaux; bancs et pupitres disproportionnés; defectueux entassement du plus grand nombre d'élèves sur le moindre espace, telles étaient les conditions de la plupart des écoles primaires avant

la loi organique de 1842. Celle-ci provoqua une grande amélioration dans cet état de choses ; néanmoins, par suite du manque de ressources surtout, trop d'écoles continuèrent à laisser à désirer. Pour bien se rendre compte de l'influence des milieux et des programmes scolaires sur la santé et le bien-être des enfants, il convient de prendre pour point de départ l'année 1874, de laquelle procèdent les modifications les plus importantes apportées au régime scolaire par le gouvernement sur les rapports du Conseil supérieur d'hygiène du Royaume. Il n'est plus anjourd'hui permis aux communes d'installer un bâtiment d'écoles comme il leur convient. Les plans doivent être soumis à l'état, approuvés par lui et les édifices, après achèvement, avec le mobilier classique être reconnus conformes aux types adoptés. Les programmes et les méthodes d'enseignement ont été considérablement perfectionnés ; le niveau des études normales a été élevé et mis au point de la pédagogie moderne ; l'inspection scolaire renforcée.

Vu le court espace de temps que les statuts du congrès nous accordent, je ne puis, pour ainsi dire, qu'indiquer sommairement dans ce rapport l'influence exercée par les règlements scolaires, sur la santé des enfants, pendant la période que nous envisageons. Je ne m'occuperai pas de l'enseignement libre dont les installations et les méthodes sont soustraites au contrôle officiel. Parlons d'abord des installations.

Le choix d'un terrain convenable étant déterminé, l'école est édifiée, à la campagne, dans une position isolée, aussi élevée qu'il convient ; à la ville, elle est séparée des habitations voisines à l'abri des bruits du dehors et de toute influence nocive. Les salles de classe, construites sur voûtes ou voussettes sur poutrelles, sont, autant que possible, situées au rez de chaussée. Les façades, disposées au S.O., sont intérieurement garanties contre l'humidité par un contre-mur d'une demi brique, isolé de 5 centim. et rattaché au mur principal par des crochets en fer. Les salles sont pavées en carreaux de ciment avec lambris en bois ou en ciment à la hauteur de 1^m à $1^m.20$. Lorsqu'il y a un étage, l'éscalier qui y conduit avec paliers de 15 en 15 marches, ne peut déboucher devant une porte ou un corridor. Les marches, droites, ont en hauteur 16 cent., en largeur, 30 cent. en longueur, $1^m.10$. Les rampes sont construites de façon à empêcher les élèves de les enjamber, de passer à travers les barreaux, de glisser sur la main courante.

Il y a une salle séparée par groupe de 50 élèves. Les dimensions sont calculées à raison de $1^m.5$ par écolier, y compris l'espace à laisser pour les couloirs, l'estrade, etc. . . . . La capacité ne peut jamais être inférieure à $1^{m^3}.750$ par enfant, ce qui donne une hauteur maximum de $4^m.50$. Les salles sont rectangulaires ; les murs peints en gris clair tirant sur le bleu.

Les fenêtres sont pratiquées latéralement et, autant que possible dans la direction du S.E. et du N.O. Lorsqu'il n' y a pas moyen de placer les fenêtres des deux côtés, on les établit à la gauche des élèves et l'on en perce en sus, quand la disposition s'y prête, dans le mur opposé à l'estrade. Le chiffre représentant la surface vitrée doit être au

moins égal à $\frac{1}{20}$ du nombre représentant la capacité de la salle. Enfin la partie supérieure du chassis est disposée pour s'ouvrir à volonté. Les fenêtres sont garnies de stores se déployant de bas en haut. Dans les classes du soir se trouvent au dessus des appareils d'éclairage des tuyaux fumivores communiquant avec une cheminée d'appel et activant la ventilation. Les réflecteurs sont distants de $1^m.40$ des tables de travail pour protéger la tête contre les degrés de température.

Le chauffage et la ventilation sont combinés de façon à obtenir une température moyenne de 14° à 17° C. avec renouvellement de l'air contenu dans chaque classe au moins deux fois par heure. Le calorifère à air chaud—que nous ne recommandons pas—mais surtout les calorifères à eau ou à vapeur sont appliqués dans les grandes écoles des villes récemment construites. Ailleurs les appareils de Geneste et Herscher, et, pour les classes de petites dimensions, le foyer Toly sont recommandés Toutefois ici, comme en quelques autres points, certaines modifications ont été apportées. Mais ce sont là des détails sur lesquels il importe peu d'insister dans cet aperçu sommaire.

Les écoles possèdent des préaux distincts avec entrée séparée pour les deux sexes. Le sol est battu, recouvert de gravier. L'espace est arboré et calculé sur une surface de $4^m.9$ par élève. Dans les campagnes un jardin de 10 acres au moins est annexé à l'école. Souvant le préau affecté aux exercises gymnastiques est couvert.

L'installation scolaire doit être complétée par des lavabos avec robinets; par un vestiaire à crochets numérotés avec cases pour les petits paniers. Enfin par des siéges d'aisances à raison de un pour 15 filles ou 25 garçons; par des urinoirs pour 15 de ceux-ci. Les siéges sont proportionnés aux âges et établis de façon à laisser visibles la tête et les pieds. Les fosses, en forme de citernes étanches, à fond concave, doivent être munies d'un tuyau d'aérage que l'on adosse à l'un des murs principaux de l'école et qui dépasse le faîte du toit le plus élevé. En tout cas les lieux sont rendus inodores par les systêmes dits à évent.

Je passe au mobilier. Les bancs et les pupitres à distances invariables, sont à deux places, avec dossiers à hauteur des reins et appropriés à la taille des élèves, lesquels ne sont pas rangés par ordre de mérite; le bord du pupitre et le bord antérieur du banc sont dans une même verticale. L'inclinaison des tables et de 15° à 20° au dessous de l'horizontale. Un modèle particulier de pupitre a été adopté pour les filles en vue de la couture. On commence à rencontrer dans les écoles des pupitres avec supports destinés à maintenir le livre à 40° pour la lecture.

Je me hâte d'aborder la question *des programmes et des méthodes*, lesquels sont établis par les réglements: Le programme des écoles primaires comporte six années d'études. L'âge d'admission est 6 ans. Dans toutes les localités un peu importantes l'enfant a été préparé à recevoir le degré primaire d'instruction à l'école gardienne où la méthode Frœbel est pratiquée. Les matières enseignées sont a lecture courante et expressive, l'écriture, le calcul mental, le systême décimal et l'arithmétique élémentaire, la grammaire et l'orthographe, la rédaction, des notions de physique et d'histoire naturelle, l'histoire nationale, et la

géographie, le dessin linéaire et à main levée, le chant et la gymnastique. Le maître a pour mission de saisir toutes les circonstances qui se présentent dans la vie commune et scolaire pour inculquer aux élèves des notions d'hygiène appliquée. Tout enseignement systématique est proscrit; il doit être absolument intuitif de la première à la dernière année. Les exercises de mémoire proprement dits sont réduits au minimum. Des cartes murales, des tableaux, des planches, des modèles, des collections de roches, d'animaux, de plantes, de graines, de produits manufacturés, de solides, de sphères, de petits appareils de physique doivent être installés dans les écoles.

Lors de la réforme des programmes, les instituteurs, un peu déroutés, se pliaient malaisément à l'enseignement intuitif de toutes ces matières. On établit des conférences pour les initier; on adapta l'enseignement pédagogique à la méthode dans les écoles normales d'où les instituteurs sortent maintenant en pleine possession des procédés. Les résultats obtenus sont magnifiques. Les instituteurs sont très pénétrés de ce fait, que l'attention qui n'est pas sontenue chez l'enfant par la curiosité disparait promptement; qu'un travail uniforme reste infructueux lorsqu'il dépasse une heure et même ¾ d'heure chez les plus jeunes. C'est avec conviction qu'ils s'attachent à observer les programmes combinés de telle façon que le nombre effectif d'heures de classes ne dépasse pas 5 heures par jour. L'entrée à l'école a lieu à 8½ h. du matin, la sortie à 11 h. ¾. Cette attelée est coupée par une suspension de 25 min. pendant laquelle ont lieu les exercises et la leçon de gymnastique, et dont on profite pour aérer la classe. La rentrée d'après midi s'effectue à 2 h.; à 3 h. relâche de quelques minutes. La classe est levée à 4 heures. Il y a congé les après-midi des jeudis et des samedis ou mardis; quelques jours de vacances à la Noël et aux Pâques. Les grandes vacances prennent en général cours du 25 août pour se terminer le 1er octobre. Nous dirons tout à l'heure un mot des devoirs à domicile.

La gymnastique est inscrite au programme du même titre que le chant et le dessin. Des prix de gymnastique sont même accordés. Il ne s'agit point de gymnastique acrobatique ou médicale, mais de celle qui a pour but un développement général, méthodique et harmonique de toutes les parties du corps, systême musculo-osseux, respiratoire, nerveux. Elle consiste en exercises libres, d'ordre, de tactique, en marche rhythmées en chantant, en jeux divers aux engins mobiles, bâtons, haltères, poids variés. Dans quelques écoles sont installées des échelles, du cordes lisses, jamais le trapêze. Les leçons sont données par les instituteurs eux mêmes qui prennent volontiers un diplôme à cet effet.

J'arrive à la seconde partie de ce rapport esquissé à grands traits, celle qui concerne les affections dont le développement est favorisé par la vie et le milieu scolaire.

Je me bornerai, ici encore, aux lignes principales.

Dans les statistiques qui relèvent les déviations scolaires, on n'a pas fait suffisamment la part des constitutions, du régime domestique des enfants, et, en dehors des médicins, les auteurs des relevés ont souvent confondu la scoliose et la cyphose. Si le régime scolaire était

seul en cause, on devrait voir les écoliers des deux sexes atteints dans les mêmes proportions. Cela n'est pas, à en juger d'après les statistiques. La scoliose proprement dite a été ou est devenue rare en Belgique. Mais nous avons rencontré plus fréquemment, la courbure à convexité postérieure, ou cyphose, à partir de l'âge de 11 et parfois de 10 ans, ce que nous attribuons aux causes qui font incliner la tête en avant dans des attitudes assises fréquentes et prolongées, pour regarder des objets de plus près, comme dans la couture surtout, la broderie, le dessin, l'écriture, le jeu du piano, etc. . . . Nous avons examiné dans des écoles d'une ville de l'arrondissement de Liège, en 1878 et 1879, un nombre de 168 enfants âgés de 7 à 12 ans, dont 101 filles et 67 garçons. Nous n'avons relevé que 5 scolioses, dont deux à un degré peu avancé; deux autres affectaient des enfants manifestement scrofuleux. Quant au cinquième cas nous devions bien le rapporter exclusivement à une attitude unilatérale gauche. Mais, à l'époque de cet examen déjà, les conditions d'hygiène, pour n'être pas strictes, n'étaient pas non plus trop imparfaites. Quoiqu'il en soit, en 1878, M. Sluys, Président de la Commission de l'école modèle de Bruxelles, voulut mesurer l'influence de l'attitude sur la scoliose. Il prit deux classes d'enfants d'un même âge moyen, ayant le même nombre d'années d'études, tous assis sur des bancs, avec pupitres également proportionnés à la taille des élèves. Dans une de ces classes l'instituteur enseigna durant deux années l'écriture penchée de haut en bas et de droit à gauche, qui s'exécute dans une station graphique unilatérale. Celle-ci est unifessière gauche; l'inclinaison de la tête à droite, un peu en avant, entraîne celle du corps. Dans l'autre classe, l'instituteur avait a enseigner pendant le même laps de temps, l'écriture droite, méthode Dierckx, dans laquelle le corps est forcé de se tenir droit. Ici, la poitrine et l'épaule se présentent carrément devant le pupitre; la main écrit vis-à-vis du milieu de la poitrine; les lettres se trouvent en face et assez nourries pour qu'il soit permis même aux yeux myopes de la suivre directement sans courber la poitrine ni fléchir la tête. Il en doit être ainsi, puisque les caractères étant presque droits, il n'est point nécessaire d'incliner la tête de l'un ou l'autre côté pour observer le parallélisme. Les résultats de l'expérience furent que dans la pratique de cette dernière méthode, il ne se produisit pas un seul cas sensible de déviation, tandisque l'exercice de la première avait amené des déviations rachidiennes à convexité latérale gauche. La méthode Dierkx a gagné du terrain, mais on se heurte dans cet enseignement non à la routine des maîtres, mais à celle des bureaucrates qui veulent l'écriture penchée.

Les attitudes vicieuses et la myopie ont des rapports immédiats. Les premières sont provoquées par la myopie et réciproquement des attitudes vicieuses résultant de la mauvaise disposition du siége et de la tablette favorisent la myopie. Ainsi pour écrire l'enfant étant obligé de se pencher, de se courber, d'incliner la tête en avant, éprouve de la congestion passive à la tête et à l'œil. Il se produit ainsi de la tension intra-oculaire, des efforts exagérés des yeux qui se rapprochent plus que de mesure des caractères; et en fin de compte, une élongation de l'œil, qui cède en arrière, c'est à dire, à son point le moins résistant. Aussi

n'est-ce jamais la face qui doit aller vers la page, mais le livre qui doit être rapproché de la face. Telle est l'importance de l'attitude dans la production de la myopie.

On comprend qu'un éclairage insuffisant ou mal dirigé détermine les mêmes effets. Or, en Belgique, dans les écoles officielles ou officiellement inspectées, les bancs étant construits dans le type que nous avons indiqué, l'éclairage, qu'il soit bilatéral ou unilatéral gauche, se faisant par des baies justement disposées en dimensions et en hauteur, les caractères des livres de classe adoptés par la Commission d'instruction étant nets, avec des lettres qui ne dépassent pas sept par centim, courant, avec des intervalles suffisants entre les mots et les lignes,—il n'y a rien de surprenant que la myopie soit devenue relativement rare.

De 1886 à 1888, j'ai examiné à ce point de vue spécial, 107 écoliers de 9 à 13 ans, je n'ai rencontré que deux cas de myopie bien caractérisées, sept de myopie faible. Mon collègue le docteur V. Desguin, d'Anvers, a constaté sur 1,500 enfants une situation non moins favorable. Dans nos campagnes la myopie est toute exceptionnelle chez les écoliers. À l'école normale supérieure de l'État, à Liége, l'examen des yeux de 115 étudiants, âgés de 17 à 20 ans, qui se sont présentés aux épreuves d'entrée au sortir de l'Athénée, soit après 12 ou 13 années d'études primaires et moyennes préparatoires, nous avons trouvé :—

À vue normale, 70 étudiants.
„ hypermétropie, 6 étudiants.
„ myopie { myopie faible 21 / „ moyenne 14 / „ forte 4 } 39.

Je ne dirai que deux mots de la chorée. Pendant une période de cinq années, 1867 à 1872, j'ai tenu une note exacte des maladies et de la constitution des écoliers, soignés tant à mon cabinet qu'à domicile. Sur 371 jeunes patients, je relevai 15 cas de danse St. Guy parmi les filles, 3 parmi les garçons. A partir de cette époque, la gymnastique fut instituée dans les écoles de la ville. Eh ! bien, en quinze années, avec un chiffre d'écoliers beaucoup plus considérable et un nombre plus que triple d'enfants examinés, je n'ai pas constaté plus de choréiques que pendant le quinquennal sus indiqué.

J'aborde la question controversée du surménage. J'entends par là une excitation soutenue dans l'exercise exagéré d'un organe ou d'un appareil et qui le conduit à la fatigue, puis à une exténuation à laquelle succède la déchéance fonctionnelle. Il en va ici du cerveau comme du muscle, avec ceci en sus de l'action organique, un processus psychique : l'attention. Par l'attention il y a effort et cet effort congestionne le cerveau. Dans le jeune âge surtout, ces congestions ou hyperémies prolongées, ces troubles dans l'innervation vasculaire aboutissent à la langueur circulatoire, et, comme conséquence finale, à l'anémie du cerveau, à l'arrêt de développement des cellules de l'écorce, suivi de l'inertie et de l'étiolement des facultés. La culture intensive du cerveau, les études précoces portent, à côté des troubles psychiques, des retentissements dans les organes de nutrition ; des orages dans l'établissement de la puberté chez les fillettes et, en général, un élanguissement nutritif qui

favorise le développement de la phthisie pulmonaire chez les débiles, chez les prédisposés. De tels effets se marquent rapidement quand les écoliers se trouvent chez eux dans des conditions de milieu et d'alimentation insuffisants, exposés en sus à conserver l'attitude défectueuse qu'imposent des devoirs à accomplir dans une mauvais éclairage, sur des tables et des siéges disproportionnés.

A première vue le programme d'enseignement primaire que j'ai rapporté, paraît encyclopédique. Il n'en est rien. L'enfant met 6 ans au mimimum pour le parcourir, et il le fait aisement si le maître procède par la méthode intuitive ainsi que cela se pratique dans nos écoles officielles. Les causes les plus actives du surménage, que plus correctement il conviendrait de désigner par le mots d'exténuation cérébrale, résident dans la surcharge de devoirs à domicile. Il est spécialement recommandé aux maîtres de ne pas donner aux enfants de devoirs proprement dits avant l'âge de 9 à 10 ans, et de les limiter à de courtes applications, à des amplifications de ce qui a été expliqué en classe; de toujours laisser à l'enfant un temps suffisant pour les exercises et la promenade. Ce qu'on observe parfois encore c'est, plutôt que du malménage, du malménage résultant d'une mauvaise interprétation des programmes, ce qui d'ailleurs devient exceptionnel grâce à l'excellente organisation des écoles normales et à l'intélligente surveillance des inspecteurs. Ou bien de l'organisation défectueuse des concours annuels des différentes écoles entre elles. Ainsi voit-on, quelques semaines avant l'entrée en lieu, les maîtres entrainer leurs élèves, par des devoirs et des leçons extraordinaires, une entassement dans la mémoire de formules et de mots, un chauffage à haute pression de l'intélligence des élèves, tout cela en vue de succès d'amour propre que poursuivent ces maîtres. Faisons observer toutefois que cette période d'échauffement est heureusement de courte durée, et qu'il suffirait de modifier l'organisation des concours pour mettre toutes choses dans l'ordre. Le surménage existe plus manifestement dans l'enseignement moyen à ses différents degrés et dans l'enseignement supérieur. Quant à ce dernier, du moins il n'y a lieu d'accuser ni les programmes ni les professeurs. On ne voit que trop souvent en Belgique, dans la chasse aux diplômes qui ouvrent l'accès aux carrières, des jeunes gens aborder les études supérieures sans préparation suffisante; d'autres, au lieu de faire à chaque jour sa tâche, laissent s'accumuler le travail et s'efforcent d'accomplir en quelques semaines l'œuvre d'une année entière. Mais ici il ne s'agit plus d'enfants dont la structure du cerveau est en voie de développement, mais d'adultes où elle est achevée. Aussi pour être sérieuses encore, les altérations dues au surménage sont elles ici plus aisément curables que dans les cas d'arrêt de développement. J'ai traité ces points en détail dans les XLVIe et XLVIIe leçons (pp. 1104 à 1156) de mon *Cours d'hygiène générale et pédagogique.* (Bruxelles, St. Manceaux, 1891.)

Dans l'exposé qui précède nous n'avons considéré que la part d'action que la loi attribue au Gouvernement. Elle a laissé à la surveillance des municipalités ce qui intéresse plus directement la salubrité courante des locaux et la santé des écoliers. C'est une lacune, car les principales villes ont seules organisé une inspection médicale scolaire

officielle. Celle-ci a pourtant donné des résultats merveilleux. Les écoliers sont dès leur admission soumis à un examen somatique qui est périodiquement répété. Le médecin inspecteur visite régulièrement chaque mois, et toutes les fois que les circonstances le réclament, les locaux et les élèves. A Bruxelles, notamment, les faibles, les porteurs de quelque prédisposition morbide sont gratuitement l'objet d'une médication préventive. Ainsi le Dr. Jaassens relevait en 1877–78–79, que de 1890 écoliers qui avaient été soumis à ces mesures, ont été bien guéris 278, améliorés 728; résultats moins sensibles ou inconnus, 844. Du côté des dents, on a rencontré 2,885 écoliers porteurs d'affections ou de vices divers auxquels il a été remédié dans toute la mesure du possible. Depuis 5 ans, profitant des récents exemples donnés par la Suisse l'Autriche, l'Allemagne, les villes de Bruxelles et de Liége ont organisé des colonies d'élèves en vacances. On soumet les enfants à un examen anthropologique minutieux, et l'on choisit les plus débiles pour constituer la colonie. Les gains obtenus en poids, en taille, en circonférence thoracique et capacité vitale ont confirmé tous les résultats constatés à l'étranger. Aussi le procès des colonies scolaires est-il aujourd'hui gagné haut la main en Belgique.

Récemment la ville de Liége a institué les bains scolaires dans une des écoles de natation situées sur la Meuse. Jusqu'au mois d'août dernier on avait relevé 5,832 bains pris par les garçons, 3,658 par les filles. Parmi ces baigneurs ne sont pas compris les élèves des écoles moyennes, ni des collèges. La balnéation est facultative, mais le nombre de jeunes baigneurs n'a cessé de croître.

Disons pour terminer que l'introduction de certains travaux manuels dans les écoles de garçons, est à l'ordre du jour en Belgique.

En résumé :—

Les conditions des milieux scolaires, aération, chauffage, éclairage, bancs et pupitres adaptés ; l'emploi de la méthode intuitive dans l'enseignement, la variété de celui-ci; un nombre d'heures de leçons en rapport avec l'âge des élèves et interrompues par des relâches consacrées aux exercices et à la gymnastique méthodiquement enseignée, des devoirs limités ; une inspection pédagogique expérimentée, des instituteurs intélligents et bien dressés, tout cela a fini par annihiler chez les enfants les dispositions aux déformations de squelette, à la myopie, à enrayer le surménage, à amener une état de santé générale favorable en diminuant les dispositions à la chlorose, à la scrofule, à la tuberculose.

Si l'état, au lieu de l'abandonner aux communes, prenait en main l'inspection médicale scolaire la Belgique pourrait s'applaudir d'avoir realisé ce but suprême de la pédagogie : developpement parallèle du corps et de l'intelligence des enfants.

Some of the Laws which influence the Growth of the Child.

BY

W. ARBUTHNOT LANE, M.S., F.R.C.S.,
Assistant Surgeon, Guy's Hospital and the Hospital for Sick Children,
Great Ormond Street.

In this paper I propose to consider the several laws which influence the form and structure of the skeleton of the human subject, in order that, by a knowledge of them, we may be able to determine the best means by which, especially during the period of development, we may improve the physique of our fellow creatures, and so, by diminishing much of the existing misery which is due largely to debility and consequent disease, enable them to compete more successfully in the struggle for existence.

The human organism is obviously evolved from a lower type in consequence of progressive alteration in the mechanical relations of the individual to its surroundings.

The shape and structure of the bones, joints, and muscles, the length and character of the alimentary canal, and the proportionate sizes of the several solid viscera are influenced solely by mechanical factors. The increased size and complexity of even the most complicated solid organ—the brain—is but a natural outcome of varying mechanical relationships, since the necessity for more complex muscular movements requires a larger development of ganglion cells, both motor and sensory, and the intellectual area is of necessity developed to meet the more difficult relationships to surroundings which result from the progressive evolution of the individual.

The causation of these changes appears to be as simply mechanical as the variations in the form and number of the teeth which result from the altering character of the food. Some corroborative evidence of this is afforded by measurements of horizontal sections of skulls I made some time ago, when I found that the left side was, in most cases, more capacious than the right, while, in two left-handed workers, I made out a greater capacity in the right side. Many of the variations in the symmetry of the skull, especially in the labouring classes, are, however, very probably due to other mechanical factors, namely, alterations in the normal position of the head, due to labour or to position of body, new functional adaptations of the head, as in carrying loads, &c., all of which render the detailed explanation of the causation of such variations in measurements most complex and difficult.

As a proof of the purely mechanical causation of the varying forms of bones and joints in man and in the lower animals, I would point to the most remarkable deviations from the normal form which the human bones and joints develop when the mechanical relationships of the individual to his surroundings are accurately determined, or, so to speak,

fixed, during the greater part of his lifetime, and thus differ from those of what is called the normal individual. I allude to the characteristic and, in a sense, extraordinary deviations from the normal which the shapes of the bones and the mechanisms of the joints of labourers present, their form and mechanism differing from those of the normal infinitely more than those of the average or normal man differ from those of the higher ape.

A very important point in relation to these alterations in the forms of bones and joints is the question of the transmissibility of the acquired form to the offspring. It seems to me to be perfectly obvious that a large proportion of the variations from the normal which are acquired during the lifetime of the individual are transmitted. How far, however, the peculiar form of the bones and joints in such labourers as the sailor, shoemaker, coal-heaver, &c. is transmitted, is more difficult to determine; but I take it that, so far as the muscular and skeletal arrangements are concerned, this transmissibility is the prime factor in evolution.

I would sum up the preceding arguments in the following concise statements:—(1.) Not only do the forms of the bones of the human skeleton vary with such movements as are performed habitually, or with such routine attitudes as are assumed by the vigorous individual, but so also do the details of the structure and the functions of the several joints. (2.) If an individual is habitually engaged in performing a certain movement or sequence of movements of activity, the form of skeleton varies from the normal in a degree which is proportionate to the length of the period during which the movement has been performed and to the amount of energy expended in the act. During a single performance of the attitude of activity there are present numerous tendencies for the bones and joints to undergo changes in form. The constant repetition enables the tendencies to become actualities. The earliest variation from the normal consists in the fixation of the physiological attitude which is normally assumed during the performance of such a movement of activity, while the latter conditions are exaggerations of the same attitude, due to changes in the bones and in the intervening soft structures. In other words, the peculiar character of the anatomy of the labourer is, first, the fixation, and subsequently the exaggeration of a normal physiological attitude of activity. These changes are all further exaggerated if developed during the period of active growth of the organism. (3.) It is highly probable that a certain proportion of the acquired variations from the normal structure of the skeleton are transmitted to the offspring if it be begotten after their mature development. This is likely to be more marked where the same unvarying and precise mechanical relationship of the individual to his surroundings continues through several generations, or, in other words, when the same occupation is pursued by several generations in sequence.

I would next call attention to the results of assuming constantly resting postures and of avoiding exercise when it is seen that as the acquired deformities of the labourer are, first, the fixation, and later the exaggeration of normal physiological attitudes of activity, so the acquired

deformities of feeble youth are, first, the fixation, and later the exaggeration of normal physiological attitudes of rest. The feeble atonic child is, for all practical purposes, an organism whose mechanical relationship to its surroundings is fixed, unvarying, and precise, and the conditions which result from this relationship, an experiment which is being made by nature for us on an immense scale, afford undeniable corroborative evidence of the statemends already made. I will summarise them briefly in the following sentences:—(4.) For the so-called normal condition of the skeleton it is necessary that during growing life the individual shall combine attitudes of activity with attitudes of rest, and that the attitudes of activity as well as those of rest shall be varied in character. By an attitude of rest is meant a position in which the superjacent weight is transmitted through a joint or combination of joints with a minimum of expenditure of muscular energy, the form of the bones and the ligaments sustaining the chief strain, the muscles in many cases performing only the passive function of a ligament. (5.) During the period of a single assumption of an attitude of rest there exists tendencies to change, both in the form of the bones and of the joints. (6.) In the young subject the rate of growth of any portion of an epiphysial line varies inversely as the amount of pressure it transmits. In other words, if one half of an epiphysial line transmits habitually an amount of pressure which is greater than normal, the amount of bone which it develops is correspondingly less than that normally produced. If, on the contrary, the other half of the epiphysial line is subjected habitually to a subnormal pressure, the amount of bone developed by it is proportionately greater than the normal. In all the resting postures the mechanism of the skeleton is such that one portion of a growing line is exposed to an abnormally great amount of pressure, while another portion is exposed to a much less or even subnormal amount of pressure. The frequent assumption of a single attitude of rest, not corrected by suitable variations in the attitudes of activity and rest, results finally in a progressive alteration in the form and function of the bones and joints. It is obvious that when these changes have advanced to any extent they cannot be obliterated by treatment, the original form of the skeleton being lost for ever. This law has a most important bearing on the evolution and treatment of acquired deformities. (7.) The more vigorous and robust the child the less likely is he to assume attitudes of rest for any time, while the feeble-bodied and frail is but little disposed to expend his scanty muscular power in activity, but prefers to assume such easy postures as make as little demand as possible upon his store of energy. (8.) The particular variety of resting posture varies to some extent with the age of the individual and with his surroundings. (9.) The density of the osseous system, together with the firmness and fit of the joints, vary directly with the muscular development and vigour of the individual. (10.) The rate of growth of bone in an epiphysial line is influenced more rapidly by abnormal pressure in the feeble and atonic than in the vigorous and robust. This is still more marked in exaggerated conditions of malnutrition, as, for instance, rickets. (11.) As the carrying of heavy loads habitually by the vigorous growing child results in a general diminution of his stature,

partly by a diminished formation of bone of a very dense character and partly by the compression of the soft structures which intervene between the bones, and especially between the bodies of the vertebræ, a short powerful structure resulting in the adult; so in the feeble, and especially in the rachitic child, the weight of the several portions of the body transmitted through its epiphysial lines results in a general diminished bone formation and in a considerable diminution in the stature. This is to a certain extent beneficial to the ill-nourished individual, since the nervous and vascular systems are able to work a shorter body with a smaller expenditure of energy than a taller one. I believe that the very small average stature of the poorer classes is due to one or other of these causes.

I may here say a few words about rickets, since it involves the following important hypothesis about which there will be doubtless much difference of opinion:—(12.) When the organism recognises that a certain development of or variation in its structure becomes advantageous or necessary to the better performance of its functions, or, in other words, when the mechanical relationships of the individual to its surroundings are such that certain tendencies exist to the formation of a perfectly new mechanical arrangement, or to the alteration of a pre-existing one, such a change is evolved to a greater or less extent. (I would illustrate this by the formation of the accessory occipito-atloid articulation in the shoemaker, as well as by the innumerable changes in the joints of labourers.)

Rickets is a condition solely dependent upon impaired nutrition, and in the large majority of cases it is due to excessive, unsuitable, and frequent feeding, not to an insufficient quantity of food. In other words, it may be described as the result of chronic indigestion of young life, and may be and frequently is acquired on a diet of breast milk only. Its frequency among our population is lamentable, and depends solely upon a want of knowledge of the most simple rules of diet. An infinity of benefit to the race would result from the thorough instruction of young girls in the manner that children should be fed, an ignorance of which is by no means limited to the lower classes.

Now in rickets we have to deal with an organism whose tissues are ill-nourished, and whose capacity for forming reparative material, or for remedying the imperfect condition of its textures, is much impaired Bone is formed hastily and badly by the epiphysial lines and periosteum, and the organism, recognising that the several portions of the skeleton are not strong enough to perform their various functions, produces a rapid deposit of soft almost decalcified bone by the periosteum, especially along the concavities of developing curves.

As the brain is the structure whose security is of the most vital importance to the organism, it causes the very much greater formation of imperfect bone upon the outer surface of the skull. This effort to render the brain as secure as possible is seen also in osteitis deformans, but even to better advantage in mollities ossium, a condition whose causation is somewhat similar to that of rickets.

In mollities, although the condition of nutrition is so impaired that the bones of the trunk and extremities are reduced to a very coarse

cancellated structure or to thin shells, yet the organism has utilised for the thickness and strengthening of the soft brain-case every bit of the imperfect reparative material which it has in store. To put this more pointedly, I would state that:—(13.) The organism is able to recognise and differentiate the varying importance of the mechanical requirements of the several portions of the body, strengthening the developing concavities of long bones, and so attempting to oppose their changing, forming, and sheltering one organ rather than another, even at the expense of other organs and structures.

It is, however, highly probable that the rapidly formed periosteal callus about the skull cap in rickets interferes materially with the perfect development of the brain. It, together with other conditions resulting from imperfect nutrition, produces, besides the other deformities, a condition of head and face which is far from being beautiful, a matter which is obviously of very great consideration in the case of female children especially. (14.) In the non-rachitic child, however feeble he may be, the diaphyses of the bones do not change their form materially other than by the abnormal rate of growth of the epiphysial lines. (15.) In the rachitic, besides a still further exaggeration of the varied rate of growth of the epiphysial line consequent upon habitual assumption of resting postures, the diaphyses yield to the tendencies to undergo change in form in proportion to the degree of rickets present.

The several acquired deformities which develop during growing life are dorsal excurvation, lateral curvature, flat foot, and knock knee.

Dorsal excurvature, is, first, the fixation, and later the exaggeration of a symmetrical posture of rest, and consists chiefly in an exaggeration of the dorsal curve and in a diminution of the conjugate of the brim of the pelvis.

Lateral curvature is, first, the fixation, and later the exaggeration of an asymmetrical posture of rest, the pelvis being rotated around an oblique axis in a horizontal plane. This produces a rotation of the superjacent bodies around an axis of varying obliquity in the same plane, the degree of obliquity being influenced to some extent by the elasticity of the fibro cartilages and the lateral connexions of the spine.

Flat foot is the fixation of the foot in its physiological attitude of rest—namely, of abduction.

Knock knee results from the abnormal rate of growth of the several parts of the epiphysial lines of the femur and tibia consequent upon the prolonged assumption of an attitude of rest.

In the rachitic infant the condition called rickety spine, a more or less abrupt posterior curve which results from the constant flexion of the thorax upon the pelvis due to weakness, is associated with a considerable diminution of the conjugate of the pelvic brim, a deformity of much importance to the female child.

If the child becomes rachitic before it has learnt to walk, bow legs result, if after, knock knee is developed instead.

Before ending this paper I would suggest that, to meet the rapidly progressive deterioration of the people, especially in and about the large towns, before a woman is permitted to engage in an occupation entailing the care, feeding, or supervision of infants or young children, or before

she be allowed to marry, she shall be obliged by law to show that she possesses a satisfactory knowledge of the general physiology, diet, and hygiene of infancy. Amongst other things that might be done, I would include the punishment of those who advertise and sell such so-called infants' foods as are extremely deleterious to the health of the child.

It seems reasonable also that those who are engaged in the education of youth in day schools or boarding schools should be thoroughly familiar with the physiology of the skeleton, and that the State should require from them some guarantee of the possession of this knowledge, which is only second in importance to that which should be possessed by those having the care of infants and very young children.

DISCUSSION.

Monsieur A. Féret (Paris) dit :—Je sollicite de votre bienveillance quelques instants d'attention, afin de vous présenter une table de travail destinée aux écoles et de vous exposer les avantages qui peuvent résulter de son emploi.

Permettez-moi d'abord de vous faire remarquer que dans les salles d'étude, les tables actuellement en usage sont de même hauteur. Cependant, les élèves sont de taille différente, quoique l'âge soit à peu près le même; de là une gêne pour beaucoup d'entre eux dont la taille n'est pas à la hauteur de la table qu'ils occupent, selon qu'ils sont trop grands ou trop petits.

Sont-ils trop grands, ils doivent forcément se courber, se pencher sur leur livre ou sur leur cahier, et s'appuyer sur le bord de la table.

Cette pression amène de graves désordres dans les organes de la poitrine, de même que la position courbée occasionne la rondeur du dos et fatigue la vue.

D'un autre côté, les élèves de petite taille sont gênés pour écrire.

La table que j'ai l'honneur de présenter au Congrès vient, il me semble, obvier à ces inconvénients par son élévation facultative permettant à chaque élève, à mesure qu'il grandit, de fixer le pupitre à sa taille.

Vous pourrez en juger, car j'ai cru utile d'apporter un modèle pour la démonstration du système.

J'espère, Messieurs, que vous serez convaincus de la bonne tenue que l'on peut obtenir chez les enfants, lorsque j'aurai indiqué les différenter positions que l'on doit, selon moi, leur faire observer en classe.

La position sédentaire des écoliers toujours assis pendant la durée de leurs études, a paru regrettable à beaucoup d'hygiénistes, et il a semblé que les travaux debout amèneraient une agréable diversion et viendraient rompre la monotonie des études.

Je n'insiste pas sur ce point et je vous laisse à juger, Messieurs, de l'utilité de l'adoption des travaux alternés, assis et debout, que la hauteur donnée à la table à élévation facultative vient faciliter.

Ne vous semble-t-il pas que le développement physique de l'enfant serait une heureuse conséquence de cette méthode?

Pour les enfants dont la vue est faible, et pour ceux qui sont atteints de myopie, j'ai créé un modèle dont le pupitre s'incline à volonté, avec facilité de le rapprocher plus ou moins, selon la force de leur vue, afin de leur éviter ainsi de se courber. Ces tables sont à une seule place. Leur banc est indépendant, de sorte que le balayage et, au besoin, le lavage sont facilités dans les classes. J'espère, Messieurs, que vous apprécierez

les avantages hygiéniquesde ce système et que le Congrès international d'Hygiène et de Démographie voudra bien s'y intéresser.

La Société d'Hygiène de l'Enfance à Paris, dont j'ai l'honneur d'être membre, m'a délégué auprès de vous, Messieurs, afin de vous assurer de ses sentiments bien sympathiques envers le Congrès dont elle suivra attentivement les opérations.

Dr. Kotelmann sagte:—Die Anbringung von Fenstern an zwei gegenüberliegenden Seiten des Schulzimmers, wie sie in Belgien üblich ist, kann zwar für die Ventilation sehr förderlich werden, auch zur Verbesserung der Beleuchtung wesentlich beitragen, ist aber für die nördlicheren Länder im allgemeinen weniger zu empfehlen, da die Heizung dadurch bedeutend erschwert wird. Namentlich in frei gelegenen Landschulgebäuden mit bilateraler Beleuchtung ist die Temperatur während des Winters nicht auf die erforderliche Höhe zu bringen.

Bei der Angabe Dr. Kuborns, dass die Scoliose in Belgien seltener als in Deutschland und der Schweiz vorkommt, ist zu bedenken, dass die Zahl der gefundenen scoliotischen Kinder sehr wesentlich von der Untersuchungsmethode abhängt. Die blosse Okularinspektion ergiebt eine geringere Ziffer, als wenn empfindliche Instrumente, wie das von Dr. Schenk in Bern konstruirte, bei der Untersuchung angewendet werden. Auch bei der Okularinspektion kann man einen mehr oder weniger strengen Maasstab anlegen und so verschiedene Resultate erhalten.

Dr. Gladstone said: These three papers all illustrate the application of exact observations or experiments to the determination of those important questions which are discussed by educationists. The tabulated observations of Dr. Burgerstein are not sufficiently numerous to warrant the plotting of a cure, but they point out the right method, and indicate that a "lesson" should not be synonymous with an "hour," but that the time should vary probably according to the sex and age of the children, as well as with the circumstances of their homes, and, of course, with the nature of the study. The weariness from continuous mental work is relieved by short rests, or by varied occupations. The observations of Dr. Kuborn are another effort to determine the effect of lessons; and if the development of the bony skeleton is so much affected by circumstances, as Mr. Lane has shown, how much more may we expect that the means of healthy development of the brain is an important subject for careful scientific inquiry?

Dr. Leo. Burgerstein (Vienna) said, I would like to say a word in reply to two remarks concerning my experiment. As to the number of children, I had intended to make the experiment apply to about 10,000 children, but I could get permission to examine four classes only. As to the pauses of five minutes between the 10 minutes' periods of work, I chose these periods of rest because I thought in this way to make the experiment resemble the ordinary school lessons. In the ordinary school lesson the teacher must dictate the additions, and this furnishes the only kind of interruption; in my experiment the children were obliged to work for 10 minutes without *any* interruption; it was for that reason that I thought to make the experiment more like the ordinary lesson by giving short rests between each 10 minutes' work. Though the basis is a small one, it will not be forgotten that the very small numbers in the single classes mostly tend in the direction of the general result.

The Resolutions proposed by Dr. Leo Burgerstein, having been seconded by Dr. Gladstone, were then carried.

Physical Education.

BY

GEORGE WHITE, Esq., B.A., LL.B., Chairman of the Committee on Physical Education of the School Board for London.

The subject of physical education, especially in elementary schools is one which, within the last few years, has attracted much greater attention than formerly; and this increased attention is one among many other phenomena indicative of the change which in the last decade the meaning of the word education has undergone. For, whereas in days gone by education meant the cramming or acquiring of a given quantity of mere information, it now has a much more extensive and developed meaning, both as to what it connotes and what it denotes. At last educationists are beginning to realise the natural interdependence of bodily and mental functions, and the consequent necessity of creating perfect physiological and psychological conditions in order to conduce to the harmonious working of the various parts of the human system and its functions, and to produce the maximum of result with the minimum of effort; or, in other words, that the educational efforts of the individual should be attended with the maximum of pleasure and the minimum of pain.

The Education Department has lately given an impetus to this greater attention by introducing into its Code an article which recognises the utility of apportioning some period of the school time to instruction in some form of physical education by allowing such instruction to be included in the ordinary time-table of the school. Art. 12 (*f*) of the Code of Regulations in 1891, *for the first time*, provides that "in "making up the minimum time constituting an attendance may be "reckoned time occupied by instruction in suitable physical exercises "and military drill."

And such bodies as the National Physical Recreation Society, the German Gymnastic Society, the Swedish Gymnastic Society, the National Union of Physical Training Teachers, and other organisations of the kind, with their consequent rivalries, are similar indications of a wave of thought passing over the country in favour of attention being given in various ways to physical as distinct from intellectual development.

The term physical education, used as denoting a subject for school instruction, has not such a wide meaning as when used generally. Its object in the former sense being partly to secure the best conditions for mental effort by promoting the best physical conditions, it includes such instruction as leads to uniform and harmonious development of the whole body of the individual child, with due regard to his physical idiosyncrasies, or any accidental or abnormal characteristics which may differentiate him from an ordinary generic child living under normal conditions. It does not include such specific or extraordinary exercise

and education as leads to the powerful arms and shoulders of the rower, legs of the runner, body of the pugilist, or the mighty physique of the professional athlete, nor anything that develops acrobatic aptitudes. Its limits, therefore, with respect to the school, and the conditions for its healthy prosecution, can be easily defined and formulated.

One of the greatest difficulties that a teacher has to deal with in the management of young pupils is the desire for change, and the natural predisposition to physical activity which always accompany infancy and early youth. The skilful teacher is he who knows how to utilise these most advantageously to make the school life of his pupil happy and interesting. The time selected for physical exercises should not be so close to the time for meals as to create any undue strain or any antagonism between the physical functions involved in digestion and those concerned in mere physical exercises as such, nor so placed in the time-table as to cause any antagonism between physical and cerebral functions. Probably a period midway in the time apportioned to mental subjects would be the best to allot to them. And inasmuch as practice and instruction in such exercises as can be taught to pupils between five and fourteen involve a certain amount of free movement for all parts of the body, and necessitate standing in a more or less erect posture, it would be best to arrange it in some part of the time-table preceded and followed by lessons which require sitting; otherwise weariness, lassitude, and undue strain and effort would result. It need hardly be pointed out that the healthy prosecution of physical education requires the best atmospheric surroundings. A lesson on physical exercises ought if possible to be given in the pure open air, of course with proper regard to temperature. A large shed in the school playground would be useful for the purpose, or a large hall in the school itself. The structure of a school, therefore, cannot be said to be perfect unless it includes one of three things: (*a*) A large shed, open at the sides, in the playground; or (*b*) a hall in the school, well lighted and ventilated, to which each class can be drafted in turn; or (*c*) plenty of floor space in each class room, unencumbered by desks, well lighted and ventilated. This latter, however, which is suggested as an undesirable alternative when there is no other, makes it almost impossible for any exercises involving marching or change of position to be practised.

Apart from its mere general hygienic results, the advantages attendant upon the teaching of physical exercises as a school subject are manifold. As a great mechanical help to school discipline it is invaluable, partly on account of the habits of ready obedience and attention to the commands and wishes of the teacher which it engenders, and partly as affording the means of securing a variety of posture and attitude to satisfy the demands of that vitality and activity which the young, under natural conditions, always exhibit.

The indirect effects it has are equally inestimable. Its aim, and result too, if properly taught, being to make children healthy and well developed, exercising in turn each separate part and function of the human body, it powerfully counteracts any hereditary predispositions to disease which may be present, and minimises their injurious tendencies.

This can perhaps best be illustrated by a series of exercises designed for the expansion of the chest and shoulders. Their hygienic effect must be at once obvious.

The object of teaching physical exercises in schools being partly to secure rest and diversion from intellectual toil and partly to make children healthy and to secure the maximum of their bodily development, it seems that they cannot be taught at too early a period in the school age, which is taken for practical purposes, as mentioned before, to be from five to fourteen. In the *infants'* school, exercises simple in character, but designed to afford development in turn to each part of the body, should be taught. Here, if at all, appears to be the only place where musical accompaniment to the exercises is desirable. For very young children such accompaniment may help towards precision of movement, and the rhythmical sounds and the pleasure resulting from sweet melodies or harmonies may add to the recreative character of the lesson. In schools for older boys and girls, however, it is doubtful, I think, whether such musical accompaniment should be encouraged. There certainly cannot be two opinions as to the undesirability of allowing children to whistle and sing their own accompaniment, which I understand to be the method with some systems, while practising physical exercises. In *girls'* schools a little reform in the matter of dress is requisite for the healthy performance of such exercises as ought to be taught. Without going into details, each part of the girl's dress should be so arranged as to allow of free unconstrained movement of the muscles and the limbs. Probably the kind of exercises taught to *boys* at school ought not to vary greatly from that taught to girls. The main object with girls, however, being to secure regular development and harmony of form; while, with boys, this being a secondary object to the promotion and general diffusion of muscular strength and to their proper equipment to discharge their duties as useful citizens, in the highest classes physical exercises may be localised and specialised with respect to their future and prospective callings. The average physique and stamina of a boy being greater than that of a girl, probably the exercises may be of a little more violent nature, and practised for a longer period than in the case of girls. Military drill ought undoubtedly to supplement the ordinary physical exercises for boys. It teaches them to walk in a regular step and manner better than any other form of physical exercises; accustoms them to grouping and forming ordered masses, and indirectly shows them the value of co-operation and the necessity and advantages of discipline.

It will be gathered from the foregoing remarks that a typical lesson on physical exercises should embrace one or more movements for each part of the body, first of a simple character, and then graduated up to more difficult and complicated ones. The length of time necessary and desirable should be sufficient to afford recreation and relief from the intellectual labour involved in the lessons preceding and following, but should not be so long as to produce weariness and fatigue, which may be as injurious as indigestion. Individually weak pupils may, therefore, require special attention. But what should be aimed at is that there

should be proper moderation and frequent repetition of the exercises. The aim and object of the exercise should, so far as the pupil is capable of understanding them, be taught with each exercise; and for this purpose a technical and scientific knowledge of physiology and anatomy is required on the part of the teacher.

In the training of teachers, therefore, for instructors in physical exercises, there should be careful study of the human frame—of the different systems which go to make up its structure, their interdependence and inter-action one upon another. With each branch of theory there should be its practical application to physical education and physical exercises. When, for example, the physiology, anatomy, and functions of the leg are being studied, particular exercises designed to develop the leg and make the performance of its functions easy and natural should be practised.

In the Swedish system of exercises, which probably has been elaborated more than any other, there are different sections devoted to—1. Pedagogic gymnastics; 2. Military gymnastics; 3. Medical gymnastics. In each branch the exercises are selected, and their order formulated to promote the immediate object in view, physiological and anatomical research and study forming the basis, and the theory and practice being taught side by side, whichever course is undergone.

The physical exercises or gymnastics suitable for the school are, of course, different from those practicable for the period of adolescence or for the adult. Exercises with apparatus involve more or less severe strain, and this severe muscular effort may seriously affect the development of the young subject. On many other grounds, too many to be here given and explained, the use of apparatus by children at school is to be deprecated, the aim with regard to them being "not at localising the "muscular effort over a limited region, but, on the contrary, to generalise "it by distributing it over a large number of muscles at the same time—"not to induce fatigue quickly, but rather to bring all the functions into "greater activity." As to the mechanical adjunct of musical accompaniment, it, no doubt, adds an element of recreation and pleasure to the exercises, especially to young children, but in elementary schools it is problematical whether it should be insisted upon for older children.

The evils consequent upon the absence of a systematic and universal provision for instruction in physical exercises are no doubt minimised, and have been prevented from obtruding themselves on public attention, by the practical outcome of that desire for activity and natural necessity for exercise which every healthy human being, whether youth or adult, instinctively and spontaneously feels impelled to in the shape of games and sport. Any organised system of physical exercises should be used as a supplement, and not as a substitute, for games. On the other hand, many games may be utilised so as to afford subject-matter for the practical application of the elements taught in physical exercises. One of the best of such practical applications is swimming, the movements in which bring into action, perhaps, more of the muscles of the body than any other form of exercise. Its value, therefore, estimated as

a subject of school instruction, and as a branch of physical education, apart from the skill and bodily dexterity which it involves and the material advantage resulting therefrom, seems to me to be incommensurable. It affords subject-matter for a kind of counterpart of physical education on land; and no child can be said to have a complete physical education until it has been taught how properly to use its limbs and how to exercise all its muscles both in the water and out of it. No school, therefore, can be said to have its educational machinery complete unless it includes in it ample accommodation for the teaching of all its children how to swim. The London School Board has lately recognised this by resolving, wherever proper public bath accommodation available for the purpose of instruction in swimming is not provided, to build in its new schools swimming baths, in order that all the boys and girls attending its schools may have their education complete in this particular. But much has yet to be done to secure that physical education should be more general than it is. Its aim in schools is hygienic and not skill; and if the discussion of it and its value from this hygienic point of view by this Congress leads to an education of public opinion in this country in its favour, much will have been done to secure its recognition as a proper subject in every school curriculum throughout the land, and to remove from us the reproach, to which we are justly liable, of being far behind other countries in the absence of proper attention being given in our schools to this important subject.

[Exercises in illustration of the different parts of the paper were performed by a class of girls from the Montem Street Board School, Finsbury, under the direction of Miss E. R. Allison.]

Physical Exercises in Elementary Schools: A part of the School Hygiene.

BY

ALLAN BROMAN.

Attention has lately been drawn to physical education in schools, and much has been said and written on the subject. Medical men and the general public began to take it up; schoolmasters, often resenting any reform in the standing regime of the school, have followed; and at the present day there is scarcely any other subject which is so conspicuously brought forward as this. At the same time, I venture to say, there is scarcely any that is less satisfactorily treated. Once a cry is raised "exercise for the children," any kind of exercise seems to be considered sufficient, the efficacy of such exercise not being taken into account at all. That such a view is not justified by facts, must be apparent to everyone who has studied the physiology of bodily exercises.

In offering a few brief remarks upon the physical education in the English schools, it is necessary to point out the great difference that exists between the various educational institutions of the country.

In the universities and the large public schools the physical education of the students takes a prominent place. Well-fitted gymnasia, swimming baths, and large fields for the systematic practice of sports and games, afford opportunities for bodily exercises of which the scholars avail themselves in the most spirited manner. No other country can be compared to England in this respect.

But in the elementary schools, to which I will confine myself, the case is quite different. These schools leave a great deal to be desired in what concerns the physical education of the child. Here, for obvious reasons, regulated physical exercises—educational gymnastics—must take the place of free games and sports.

Everybody who has studied child-life in its different phases, knows that there is one thing especially which strikes the observer, namely, the incessant and irrepressible need of movement that every healthy child exhibits. The cause for this is to be sought in the natural laws according to which the whole development of the child takes place. Physiology teaches us that muscular exercise is simply necessary for the growth of the child; as necessary as food and air to attain the development, physical and mental, that nature intended. Depriving the children of the opportunities for free movement is, therefore, a direct violation of nature's laws, and cannot be done without harm to their organisms.

When the child begins school its conditions of life are at once considerably altered. From freedom it is brought under restraint; from the perpetual motion which its body requires, it is placed on the school bench and told to "keep still," an order which, as every teacher knows, is obeyed with great difficulty. This alone would be sufficient to impede and prevent the natural growth and development of the child. But on the forms bad positions are often taken and sustained for some time by the pupils. The injurious effects of forced inactivity are thus aggravated, and the result is, too often, deformities of various kinds. Hence it is that we see so many children afflicted with those so common ailments, popularly called the poking chin, the stooping shoulders, the flat and narrow chest, generally combined with spinal curvatures of one form or another. It is interesting to note how all these defects directly attack the chest, just the part of the body which, containing organs of such vital importance as the heart and lungs, ought to be particularly protected.

If we consider the cause of all these deformities, the remedy will be found near at hand; for it only stands to reason that if muscular inactivity and bad positions *can* cause and *do* cause an evil, the contrary—physical exercises consisting of rightly-chosen movements, carefully executed in good positions—will, if used in time, counteract the bad influences, and prevent the irregular development. And that such is the case has been abundantly proved by experience.

Therefore, although the studies in school compel the children to muscular inactivity for a certain time, which cannot be prevented, we must by suitable exercises prevent them from suffering harm physically;

and it becomes an imperative duty in the management of the school to see that this is effectively done.

The aim of physical education is a harmonious development of the body. Remembering the grave dangers we have just mentioned to the natural development of the child consequent upon school life, it is clear that these must first of all be averted. The exercises must therefore, in the first instance, be *corrective*, that is to say, directed towards widening of the chest, straightening of the spine, a correct carriage of the head and shoulders. The greatest attention should be paid to their effect upon the respiratory and circulatory organs. To attain this, the muscles must be the *means*, not in themselves the *end;* for a muscular development is not always a sign of bodily health. If attention be paid to such developments mainly, harm is often done to vital parts. It is well known that heart and lung diseases are the professional ailments of acrobats and others who make violent gymnastics their aim in life.

A most important matter, although often neglected, is the *sequence* of movements in the lesson. When we reflect how every movement has its effect, local and general, upon the system, it is clear that the exercises must not follow each other anyhow, but with due regard paid to this effect. For instance, an exercise which has unduly increased the action of the heart and lungs must be followed by one which has a quieting influence upon the same organs.

It is often urged that the exercises should be made a recreation for the children. This is true enough, although not in the sense in which it is generally spoken. For by "recreative" is, more often than not, meant "amusing" exercises; and to provide amusement is not the aim of Physical Education. But recreative in a higher sense of the word, bodily exercises, rightly executed, certainly are. For by muscular activity the blood is drawn from central to peripheral parts of the system. Congestions to the brain and pelvic organs—caused by intellectual work combined with long sitting still on the school-benches — are thus relieved; and a re-action takes place as beneficial to the mind as to the body.

Regarding the question of physical education from the *hygienic* point of view, there can scarcely be any doubt as to the place that should be allotted to the subject in the ordinary school routine. It cannot very well be compared with the other subjects taught in school. Its aim and the object of its introduction in the school work are different. Here the instruction does not mean preparing for an examination with questions and answers. It means rather the supplying of a want, the want of movement which nature requires for the healthy development of our children. What is the use of well-constructed forms and benches in the school, if the children are not able to carry their spines erect and avoid curvatures of different kinds? What is the use of airy, well-ventilated class rooms, if the children have not got large enough lungs in their narrow chests to benefit of the fresh air? What is even the use of intellectual instruction, if the overtaxed brains of the children are not capable of digesting the mental food they get during school hours? Let, therefore, physical education take its place amongst and complete the hygienic arrangements in the school. If looked upon as a part of

the school hygiene, much of the opposition and prejudices by which its progress is now hampered will vanish, and many misunderstandings regaridng it will disappear. To be of any use a proper amount of time must of course be given to the subject. That the lessons ought to be of daily occurence is only natural, since the defects in School-life which they are intended to neutralize are always at hand. It is an important question in itself and worthy of earnest consideration. But less than half-an-hour each day cannot be proposed seriously, if the children are to derive real and lasting benefit from their work.

As already remarked the subject is not yet arranged on a satisfactory basis in the elementary schools. Military drill or physical exercises are certainly taught in most of them, but the exercises lack strangely both in quantity and quality. In quantity, because the time allotted is insufficient; in quality, because the exercises are badly chosen. The reason for this is, no doubt, that the subject has been and is looked down upon; time and thought are unwillingly bestowed upon it.

The teachers—mostly excellent as instructors—lack, as a rule, the theoretical knowledge necessary to choose and combine the movements to the greatest benefit of the children. Exercises are copied either from the acrobat's tricks or from military gymnasia. The latter are by far the best, but the teachers—often old soldiers—ignore that what is excellent for the development of muscle in a healthy, full-grown man may be entirely unsatisfactory and even dangerous to a growing child.

In addition to this comes the love of display, which has been carried to such an extent that often the real hygienic and educational object of the exercises is quite obscured. Movements are executed to music, and everything, form and usefulness, is sacrificed to the time of the piano or the rhythm of the song, as the case may be.

It is evident from these few facts that reforms are required. Neither are signs of improvement wanting. In many schools throughout the country, especially girls' schools, physical education has been introduced in a rational manner. The School Board for London has for several years paid some attention to the subject, and with good results.

In most cases these improvements are based upon the s.c. Swedish system of gymnastics, a system as yet very imperfectly known here, but well worthy of a thorough study. On the Continent attention is now directed towards this system of physical exercises, and publications have appeared lately which treat of this branch of education with special reference to its standing in Sweden; of these I take the liberty to mention two. One is a pamphlet by Dr. E. Meyer, printed in Doberan, 1889, and bearing the title, "Zur körperlichen Erziehung der Jugend." The other is an article by Dr. Fernand Lagrange, well known for his previous work on the physiology of bodily exercises. It appears in the April number for this year of the "Revue des deux Mondes," and is called "La Gymnastique à Stockholm." Both authors speak from personal knowledge of the subject, having spent some time at the Royal Gymnastic College in Stockholm, and recommend a study of the Swedish system on account of its thoroughness, scientific basis, and obvious good results upon the youths.

In England, with the Englishman's well-known love for bodily health and vigour working in its favour, there should be a bright future and rapid progress for physical education. But time and a distinct place in the school curriculum must be given to the subject. This, I think, would be best accomplished by insisting upon educational gymnastics being introduced as a part of school hygiene, to which the exercises, as pertaining to the healthy development of children, rightly belong.

DISCUSSION.

Lord Meath expressed his thanks to the Chairman of the London School Board and to the Chairman of the Physical Education Sub-committee for the advances which have been made by them in introducing physical exercises into their schools. He was convinced that in our large cities large numbers of children in the poorer parts were distinctly degenerating in physique, and that it was absolutely necessary that the care of the body should go on side by side with the cultivation of the mind. He had lately returned from Norway and Sweden, and had seen splendid gymnasia attached to the ordinary schools; this led him to doubt the justice of the statement made by Mr. White that the use of apparatus was to be deprecated. Dr. Brooker, of Much Wenlock, had clearly shown that children who had been taught military drill combined with gymnastics showed a better improved physique than those who had only been put through a course of military drill alone. Lord Meath referred to statistics given on this point in an article he had written in the June number of the North American Review for 1891. Teachers of gymnastics should always be the ordinary teachers of the school, and never be taken from outside for several important reasons, also mentioned in the above article. He trusted that the swimming-baths built by the School Board would be fitted up in winter as gymnasia. He asked for support for the Bill on physical education he had introduced into the Upper House placing physical exercises, as regard schools in towns with a population of over 15,000, in the category of those subjects which must be taught by every school authority desiring to obtain the highest Government grant.

Mr. Noble Smith thought that the proposal to allow a quarter of an hour's recreation in each hour, even if not quite accurate in degree, was a step in the right direction. But before we arrived at this state of perfection we ought to abolish all out-of-school work. While acknowledging the great benefits of physical exercises, he thought that they should form a part of the work of school and not of the play. Long walks differed, he thought, from physical exercises in that they produced a strain of one set of muscles. That due rest should follow all exercise, he urged as very necessary. He proposed the following *Resolutions*:—

1. That all out-of-school work be abolished. This, having been amended so as to read "That the hours for home lessons should be restricted," was *carried.*
2. That ample physical recreation should be carried out. This resolution was *carried.*
3. That long walks are undesirable. This was *lost.*
4. That in the intervals between exercise the body should be properly rested. This resolution was *carried.*

The Value of Hygienic Education to Women.

BY

A. T. SCHOFIELD, M.D.

However great the advance has been in the general education of women during late years, there is still a missing link of vital importance in the chain as long as personal and domestic hygiene is not regarded as a most essential part of their education; and it is a subject to which the Council have rightly accorded a place in this Section of the Hygienic Congress. With regard to hygiene, women have actually and relatively lost ground as compared with men. In the darkness of the middle ages not only were women generally better scholars than their knightly husbands, who were often unable to read or write, but whatever knowledge of hygiene existed, or of the curative art, or of nursing, was found with them. In many cases the women, with their stores of simples, represented the entire medical practice of the neighbourhood.

The great modern advance in the education of women in arts and sciences is but a somewhat tardy attempt to regain their lost position, and one to which every one desirous of the improvement of the race will wish God-speed. All that we could now urge is not that other studies should be curtailed, but that amid the less generally useful studies of chemistry, botany, physics, &c., the science of hygiene should take a place commensurate with its undoubted importance to human health and happiness.

As to this importance, let us hear Herbert Spencer:—"If any one "doubts the importance of an acquaintance with the principles of "physiology as a means to healthy living, let him look around and "see how many men and women he can find in middle or later life "who are thoroughly well. Only occasionally do we find vigorous "health continued to old age; hourly do we meet with symptoms of "acute disorder. Here is a case of heart disease consequent on a "rheumatic fever that followed reckless exposure. There is a case of "eyes spoiled for life by over-study. Yesterday we heard of one "whose lameness was brought on by continuing, in spite of the pain, "to use a knee slightly injured. Now we hear of an irremediable "injury which followed some silly feat of strength. Is it not clear that "the physical ills which produce this ill-health to a great extent make "life a failure and a burden instead of a benefactor and a pleasure."

This science, however, still remains the most neglected of all the sciences. And yet it is in every way peculiarly adapted for women to learn. Its principles can be easily acquired, and are not hard to remember; and while some may doubt the wisdom or the necessity of having women as doctors in this country, none can deny the extreme value to those who naturally have the care of the house and home, and of children and the sick, of learning all they can about the science of prevention, which is better than that of cure.

The present loss of life in this country from preventible causes is still disgraceful. Taking the number of deaths as 500,000 in a year, it is found that only $\frac{1}{10}$th of these persons reach 75. Of the 450,000 who die before that age it has been computed that about 250,000 die from preventible causes; and taking the number of sick cases to deaths to be as 28 to 1 (a moderate proportion), we get an aggregate of some 7,000,000 needless sick beds every year, with all the sorrow, distress, and loss of time and money that they involve. Taking the population as 35,000,000, and allowing five to each family, this makes one case to each household in the kingdom that they represent. Public sanitation has already done much to improve this state of things. In 1888 there was 140,000 fewer deaths and a proportionately less number of sick beds than in the average from 1840–1875, in which latter year the Public Health Acts were consolidated.

But great though the advance may be, Lord Derby says:—"Sanitary instruction is of the two even more essential than sanitary legislation. Nothing can supersede the value of personal and private care."

If public sanitation has been mainly effectual in reducing the death-rate in old cities one-third and in new cities one-half, and in raising the average duration of life from 20 years in the 18th century to 36 in the 19th, what may we not expect from the spread of hygeinic principles among the people and a knowledge of its laws among the mothers and mistresses of our country? The leading diseases—consumption, bronchitis, inflammation of the lungs, convulsions, and scarlet fever, are all more or less clearly preventible, and are constantly being prevented by hygienic care.

Dr. Farr considers that the proper duration of life is five times that of growth, and putting this down in the human species as 20 years, we arrive at 100 being the full span of existence apart from inherent or acquired disease. This of course only gives the general length of life. As a matter of fact no absolutely healthy child is probably ever born into the world—so universal is the heritage of diseases, and thus the general span is lessened by one fourth. The individual expectation of life can be best ascertained by adding together the ages of the parents and four grand-parents at death and dividing by six, adding one year for every five if the result be over 60, and deducting one year for every five if it be under 60. It is, we submit, the bounden duty of every person to live out, if possible, his allotted span of life, and there can be no doubt that a personal knowledge of hygiene is the best means to succeed in this.

Let us now see what is included in the comprehensive word hygiene. Its tremendous elasticity is evidenced by the diverse and far-reaching aims of this Congress. In its present use in this paper we include all that pertains to the health of the body, and in our opinion the general instruction to women should include the following items: a practical course of lectures on physiology, with outlines of anatomy; a course on nursing; on first aid to the injured; on house sanitation and ventilation; on food and its uses; on cookery, and on any kindred

subjects that enforce the five laws of healthy living—good air, good food, cleanliness, suited exercises and rest, and healthy clothing.

I have earnestly attempted to carry out part of this programme for years; but increasingly feel that isolated efforts, however arduous, do not meet the necessities of the case, and that it should form a most important part of the work of our great societies, such as the Sanitary Institute and the National Health Society. These might organise and equip a hygienic college for women on a sufficiently broad basis to attract the educated and cultured classes, while at the same time providing for the needs of the poorer women.

It remains for me to establish my point of the special value of the teaching to women and specially with regard to the preservation and proper training of young life. We may consider its value to women under the following heads:—as women; as wives; as mothers; as mistresses; as governesses and teachers; as nurses; and as workers.

As *women* the knowledge of personal and domestic hygiene is of value, 1st, for oneself, and, 2nd, for others. For oneself there is no doubt whatever of its value in prolonging life, in preventing sickness, and in preserving beauty. It is pitiable to think how many at this moment are leading lives of suffering and of comparative uselessness, who, had they possessed this knowledge, might have been strong and useful. With regard to its value for others, a lady well-known in London society writes to me as follows:—"How sadly can I add my "testimony to the dangers of this lack of hygienic knowledge; for the "dear ones whom I have lost in my own family might have been "saved—*all* were lost to me through preventible illnesses; and how "many a mother has gone through the same agony which might have "been prevented had such knowledge been given her. Would that "we could open the eyes of those who are careless on these subjects "to the mistake they are making, and to the importance and necessity "of hygienic knowledge. Were people *thoroughly* aroused and con-"vinced that their ignorance is positively culpable, I believe they would "flock anywhere to learn all that they could."

Consider also the intrinsic interest of the subject to women, and how peculiarly suited it is to them from its domestic nature and sphere of application.

Observe the pitiable paralysis that comes over an otherwise clever woman from lack of this knowledge at the time of some sudden accident. This knowledge not only increases the usefulness of women in every way, but is of special value in connexion with doctors' visits. So far from making women quacks, such knowledge alone enables them to appreciate medical skill, and ably and intelligently to carry out the doctor's orders.

Look at its value to *wives*. How much drunkenness is due to insanitary and disorderly homes, to ill-cooked and ill-chosen meals, to dirt and disease of all kinds? When we consider that among the poor a man's health is literally his fortune, and the sole support of his wife and children, we see how essential it is that, whatever else the wife may be ignorant of, she should have a working practical acquaintance with

those laws that enable her to keep the home healthy and clean, and to nurse her family efficiently in sickness.

As a *mother* her knowledge of hygiene is perhaps of even more practical importance than as a wife. When we consider that even now amongst the poor the mortality of infant life is 50 per cent., and when we find among the rich it is not above 5 per cent., we know much is preventible, and in many cases surely amounts to homicide. Nor is it possible to justify such slaughter on Darwinian grounds, for it is by no means the unfit that succumb, but children who might have made strong and valuable men and women. If we remember that *four* out of every *five* infants who die, do so from bad food in some shape or other, surely we shall plainly see that a thorough knowledge of the food suited to infant and child life is a most essential part of a mother's education. Consider, again, how as the child's body grows, it may be well or ill shaped, dwarfed or properly developed. It is found that of two boys of 15, one well cared for and fed, the other with poor food and unhealthy surroundings, the former will average about three inches taller and a stone heavier. But this is not all. There is a hygienic training of mind of still greater importance. Hear, again, what Herbert Spencer says: "The training of children physically, morally, and intellectually is "dreadfully defective . . . . *because* parents are devoid of that "knowledge by which alone this training can be rightly guided. Is "it not madness to make no provision for such a task? Better "sacrifice accomplishment than omit this all-essential instruction. "Judge, then, whether all who may one day be parents should not "strive with some anxiety to learn these laws."

Again, as *mistresses*, how invaluable this knowledge becomes. As a rule, a man knows very little about a house beyond the rooms he occupies. It is the mistress who inspects the lower regions, who knows where the cistern is, who sees the dustman call, and who scents incipient sewer gas. How important, then, nay, how absolutely essential it is, that the young girls of our country, ere they marry, should be carefully trained in the knowledge of what pure air and pure water mean, and the causes and varieties of domestic poisons. The one subject of ventilation, and how to secure pure air throughout a house without draught, is of the very first importance to health, and no greater benefit could befall our working population, as well as the whole population, than thoroughly to explode by hygienic knowledge the widespread prejudice against night air.

When we consider women who have officially charge of other people's children, such as *governesses*, *teachers*, *nurses*, &c., we are increasingly struck with the necessity of this knowledge. We confidently hope that the time is not far distant in this country when the first requisite for any such post will be the possession of a proper certificate of proficiency in the hygiene of childhood. Observe how this science pervades every detail of their duties. How it regulates the hours of study, suiting them to the child's strength and growth; how it determines the arrangement of light, air, and ventilation in the schoolroom and nursery; how it arranges the very posture of a child when sitting

and standing; how it regulates the amount of exercise, rest, and sleep required; how it detects in time incipient signs of disease; and how it gives the proper place to the due development of the body by calisthenics and games.

As *nurses* this knowledge checks the pernicious system of nursery quackery by patent medicines and soothing draughts; it regulates the food and dress of the children; and, in short, greatly checks any disease arising from preventible causes.

Finally, when we consider women as *workers* amongst the poor, and missionaries of various sorts, it is needless to point out how their value is doubled by such knowledge. It is for this reason we so desire its spread among the educated classes, that they in their turn may disseminate it amongst others.

Some ladies have large numbers of dependants, among whom disease is more or less endemic. Let them imitate the noble example of the writer of the letter I have read, who, after hearing two lectures on this subject, was so impressed with its importance that she straightway worked up the subject, and returning to her Highland home, in the schoolroom on her estate gave to her tenantry four of the best addresses I have ever read on every-day hygiene.

We are delighted to know that the County Council of Devon have grasped the value to the poor of this teaching, and have lately, with the aid of the National Health Society, carried it out on a large scale.

What we insist on in this paper is that for the sake of their children, their servants, their husbands, and their homes, their neighbours, and, lastly, themselves, it is the duty of every woman in England to acquire a sound knowledge of hygiene, whatever other branch of learning she may neglect. I have no time to point out how this great end may be best attained, or to notice the various efforts already made for this purpose, but I certainly think the time has come when the societies I have named should bestir themselves to more vigorous efforts.

Manual Training in relation to Health.

BY

SIR PHILIP MAGNUS.

Among the many changes that have taken place in the system of national education during the last decade, by no means the least important is the practical recognition of the principle that education is the right development of all, and not of some only, of the faculties of mind and body in preparation for complete living. As regards the mental faculties, we were accustomed in times not so long ago to speak of the five senses as the sole agencies through which mind and the external world were brought into close relation. Of these five senses, the eye and the ear were not only the chief, but the only sense organs

that were utilised, and these only in so far as they served for the exercise of memory. Education consisted mainly of repeating facts acquired at second hand. The senses themselves, as organs of perception, were very little cultivated, and among these the muscular sense was not included. Yet it has now been long known that much of the knowledge which we acquire by the direct action of the eye is the result of muscular changes, and that by far the greater part of our knowledge of the external world is due to the action of the limbs, and to the muscular impressions produced upon the brain through the calling into play of the appropriate nerve-centres. With all this Physiology has made us fully familiar; but education (which, from its theoretic side, may be regarded as an applied science) has been slow to recognise the necessity of cultivating the muscular sense as a means of acquiring knowledge. Indeed, the acquisition of knowledge at first hand has been little considered. The revolution that is associated with the New Education is little more than a protest against teaching by authority, and the substitution therefor of teaching by observation and experiment; and this new departure implies the training of all the organs which are concerned in giving exact notions of the things about us. This is a great advance on learning by memory only. The New Education demands the careful training of all the organs by which knowledge is primarily acquired. It rests, therefore, on a psychological and physiological basis. Manual training is claimed as a subject of school instruction, because it serves to exercise conjointly, and in harmony with one another, the muscles and nerve-centres of the hand and eye, which are concerned in perception.

This is the intellectual side of the argument for the introduction of manual training into our schools.

Although of importance in the education of all children, workshop instruction is of more importance in the training of those who have mainly to employ their hands, as helping to create aptitudes and to fix sense-impressions in the brain, which will subsequently prove serviceable to them. Regarded from the economic or industrial point of view, much has been said of late in favour of manual training, in connexion with the question of technical education. To our young artisans there is little doubt that instruction which serves to exercise the hand and eye, to teach exact notions of form and size, of mass and hardness, and to enable the hand to represent on paper, and to reproduce in material what the eye perceives, is most serviceable; and if, at the same time, the instruction can create aptitudes for using instruments of precision, and can develop handiness concurrently with the training of the intellect, its educational value must, in course of time, be generally recognised.

It is only five years ago, at the Birmingham meeting of the British Association, that I ventured to put forward these arguments in favour of manual training, and, relying mainly upon my experience of foreign schools, to urge upon the authorities responsible for our education the desirableness of introducing such teaching into our public elementary schools. At that time France, Belgium, and Holland had brought the workshop into the school, and the system of manual instruction, known as Slöjd, was generally adopted throughout Sweden. In the United

States the new idea was readily seized, and societies were established, and a whole literature came into existence to advocate manual training. As authority for such an innovation in our methods of instruction was needed, it was pointed out that similar teaching had been strongly recommended by many of the most eminent writers on education of all times; and Comenius, Locke, and Rousseau were quoted in support of this new subject of instruction.

The progress of the movement during the last few years has been very rapid. Tried experimentally in one or two schools at first, and later on more systematically in London under the auspices of the School Board and the City Guilds Institute and the Drapers' Company, this subject, which is now formally recognised in the Education Code, is likely before long to be generally adopted in our schools. Already there are over 700 boys under instruction in connexion with the School Board of London. These children vary in age from 11 to 14. They come from 61 different schools, and receive instruction in nine centres in the metropolis. But at present we are only at the beginning of the movement. New centres of instruction are being rapidly formed, and before the end of 1891 it is expected that in London alone provision will be made, under the London School Board, for the manual training, in properly fitted workshops, of nearly 3,000 boys. In other cities, particularly in Manchester, Liverpool, and Birmingham, equal progress has been made. So that before long we may expect to find the whole of our future artisans undergoing a supplementary training altogether different in kind from that which, during the first twenty years, has been provided in our public elementary schools.

There is another aspect in which manual training may be considered, which is of equal importance with the intellectual and industrial points of view, and that is in its relation to the health of the children. Experience and theory both show the value of the instruction as a mental exercise, and as a serviceable preparation for the actual work of life. But in education the *corpus sanum* has to be considered as well as the *mens sana*, the healthfulness of an occupation as well as its intellectual character and utility. In visiting foreign schools I have been struck with the superior physique of the boys engaged in the school workshops over those occupied for the whole day in sedentary pursuits, and these observations have left no doubt in my mind that manual training conduces to physical growth and development. But casual observations such as these do not count for much, and the subject is one well deserving further inquiry.

Some few years ago there was a great outcry that the children in our elementary schools were being over-instructed, and that their minds were being educated at the expense of their bodies. The cry of "over-pressure" was everywhere heard, and many trustworthy authorities and others who were silently opposed to all education of the people proclaimed that we were injuring the physical constitution of our future working classes, and were training a body of short-sighted, narrow-chested, muscularly weak artisans, whose smattering of learning would prove no adequate compensation for their deterioration in physique. The outcry did some

good, for it drew attention to the condition of elementary education, and accelerated the improvements which have since taken place. Careful investigation showed that children suffered more from ***under-feeding*** than from ***over-pressure***, and soup kitchens and penny dinners have since been more liberally provided. But the causes of under-feeding could not, unfortunately, be permanently removed; and allowing for some exaggeration in the "over-pressure" cry, it was ascertained that the conditions of our primary instruction did tend to encourage undue pressure of both teachers and pupils. The competition for money grants on results was altogether unwholesome and has been gradually discontinued. But apart from that, the education provided in our schools was shown to necessitate too much sitting, too much reading and learning by heart, and to take too little account of the natural and spontaneous activity of the child. It failed to develop the child as a whole, in accordance with its physical constitution, and the natural overflow of vital energy was restrained instead of being directed into channels of future usefulness. The remedy for this could not be found in mere physical exercise—in drill, gymnastics, or in ordinary recreation; for these subjects occupied a large amount of time and could not well be made educational in character. The school hours, if devoted exclusively to book learning and employed in sedentary occupations, were too long and proved too great a tax upon the child's strength, and the system failed to ensure at once healthy development of body and intellectual progress. What was needed was a subject of school instruction, which, through the exercise of the muscles, should stimulate the brain and at the same time secure intellectual discipline. This was found in manual training. Experience shows that where manual training has been introduced into schools, it is helpful in maintaining the body in a healthy condition, whilst serving at the same time to stimulate the mental powers. Theoretically this is only what one would expect, but experience has verified the expectation. M. Salicis, the founder of the Ecole Tournefort at Paris, to whom the movement in favour of manual training is so largely due, tells us, after an experience of 16 years of Paris schools;—"The children thrive, "notwithstanding that their attendance in school is longer by two hours "than the regulations provide." And the instructions placed at the head of the programme for manual training, now observed in all French schools, fully recognise the advantage of such teaching from a hygienic point of view. In defining its object, we are told—"Manual training "has a double purpose, one of which is to strengthen the body, to "invigorate the constitution of the child, to place him in the hygienic "conditions most favourable to a general physical development." From all countries we have testimony of the salutary influence of this training, and our own experience shows that, apart altogether from the industrial advantages which children derive from the aptitudes it creates, it quickens their intelligence, and increases their interest in their ordinary lessons, enabling them to fix their attention with less loss of energy upon their other studies.

There can be no doubt that the concurrent development of all the functions and faculties of the child is an indispensable condition of

healthy education. Without some kind of manual training this cannot be effected. We are told that the brain consists of distinct parts which subserve separate offices, and that certain nerve-centres situated within the brain initiate and regulate through the will distinct muscular actions. These nerve-centres appear to control actions which are more susceptible of educational influences than the reflex actions referable to the spinal cord; and the development of these motor centres, and consequently the due development of the brain, of which they form a part, depends upon their being called into use and properly exercised. It would appear, moreover, that each such centre has a definite period of growth during which the exercise of the organ it controls conduces most to its development, and that if this exercise is neglected the nerve action in the brain is enfeebled and the activity of the organ is impaired. It is important, therefore, that education should seize upon the organ during the period of development of the corresponding nerve-centre, if the organ is to be trained to most advantage. Experience fully confirms these inferences from experiments, and shows that manual dexterity and nearly all other aptitudes are best acquired during childhood, and that no amount of exercise in after life can compensate for omissions in our early youth. Sir James Crichton Browne, who is perhaps an unwilling witness to the advantage of introducing manual training into our elementary schools, tells us, "The nascent or development period of the hand-centres has "not yet been accurately measured off; it probably extends from the "first year to the end of adolescence; but there can be no doubt that "its most active epoch is from the fourth to the fifteenth year, after "which these centres become comparatively fixed or stubborn." And he goes on to say that boys and girls whose hands have been left altogether untrained up to the fifteenth year are practically incapable of high manual efficiency ever afterwards. In this statement we have a powerful argument, from the economic point of view, for making hand and eye teaching concurrent with other instruction throughout the whole period of a child's primary education. But I do not desire now to dwell upon this aspect of the question, but to indicate rather the general effect of such training on a boy's health. On this point the same authority may be again quoted with advantage. He says, "The boy who is reared with "his hands bandaged physically or morally, or who is by any means "withheld from ample exercise and varied discipline of these wonderful "and willing organs, must grow up to some extent feeble and in-"capable;" and he adds, "Depend upon it, much of the confusion of "thought, awkwardness, bashfulness, stutterings, stupidity, and irresolu-"tions which we encounter in the world, and even in highly educated "men and women, is dependent upon defective or misdirected muscular "training, and that the thoughtful and diligent cultivation of this is "conducive to breadth of mind as well as to breadth of shoulders."

It may be taken then as proved that without exercise that brings into discriminative use the muscles of the hand, the brain itself may be said to be only imperfectly developed, and the general vitality is lowered in the same way as if any other sense is not utilised. But it is owing to the general and uniform muscular development of workshop exercises

properly directed, that the health of school boys between 11 and 15 years of age is undoubtedly improved. To the children of all classes such training may be considered, on purely intellectual grounds, a necessary part of school education, and it is satisfactory to know that workshops have been recently attached to many of our public and endowed schools. But to the children who frequent our national schools, and who form the bone and sinew of our population, such training is still more important, not only intellectually, industrially, and morally, but also in its bearing on their muscular development. The conditions under which they live give fewer opportunities for healthful physical exercises than are enjoyed by children who are placed in more favourable circumstances; and the fact that the majority of these children will be occupied with manual work during the greater part of their life is an additional argument for utilising a part of their school days in training the organs, on the usefulness of which their future progress so greatly depends.

Dr. Woodward, to whose intelligent and well-directed efforts the development of manual training in American schools is largely due, takes for granted, without argument, the hygienic value of such instruction. "It almost goes without saying," he tells us, "that the varied "exercises of a manual training school are highly conducive to physical "health."

It is a fact of some importance that the introduction of workshop instruction into schools has the effect of lessening the necessity for punishment. I think we may assume that any education in which punishment is frequent is an unhealthy education. The effect of punishment is to depress the nervous system and to diminish the intellectual energy needed for school work. Even where, under the influence of fear, better results are temporarily obtained, the general vitality of the child is lowered by punishment, and the educational results are less satisfactory than they might have been. The progress of educational science is shown nowhere to greater advantage than in the decrease of punishment as a means of school discipline; and the effect of these improved methods on the health of children generally, and particularly of children of nervous temperament, cannot be over-estimated.

Manual training is a school exercise which is not only attractive in itself, but quickens a child's interest in many of his other lessons, and the desire to take part in the workshop instruction is a wholesome inducement to attention and to general good behaviour. In the course of time there is no doubt that by adequately exercising, without subjecting to any painful strain, the various intellectual organs, all school lessons will be made sufficiently interesting to render punishment quite unnecessary. The addition of manual training to the curriculum of schools marks a very important step in this direction.

In order that workshop instruction may yield its maximum hygienic value, it must be given under conditions favourable to health. First of all, the school workshop must be constructed on approved sanitary principles. Hitherto we have been content to take any spare room, fit it with benches, and use it as a school workshop. But with the general adoption of manual training, the construction of the school workshop has

to be carefully considered, both as regards its size and shape and the best means of lighting and ventilating it. Then, as to fittings, we have to determine the proper height and arrangement of benches, the best kind of tool racks, &c. The mode of handling tools and the position to be occupied by boys at work so as to prevent injurious muscular development, are also matters of importance in their bearing upon the health of the children. On these and on many other points teachers will require to be informed, if manual training is to become a healthy exercise and is to occupy a prominent position in the school curriculum.

To some of these questions experience has already provided answers; others still await solution. A top-lighted shop, for instance, is not considered as good as one lighted from the sides. As regards the character of the instruction, lathe exercise is not considered as good as bench work. Most of the French schools are provided with lathes, and the boys work in groups of three to each lathe. But on this point M. Sluys, the director of the Normal School at Brussels, well says:—"The turners' work is always difficult, and not without danger; besides, "it calls for a one-sided effort. We cannot, therefore, give it a "prominent place in school work. In a word, woodwork without "carving or turning is sufficient to attain the general result sought." This view has guided those who have had the direction of manual training in this country, and is in accord with the opinions expressed by other educationists. Rousseau says, "The trade I should prefer my "child to choose would be that of a joiner (and by trade Rousseau only "means 'manual exercise') it is neat, it is useful, it can be practised in "the home, it keeps the body in tolerably good condition." The lessons given to teachers at the City and Guilds Central Institution have been restricted to bench work, and in the syllabus of examination for teachers' certificates, recently issued by the City Guilds Institute, "woodwork without turning" forms the main part of the examination.

I need scarcely say that not only the intellectual but also the health value of the instruction depends very much upon the intelligence and training of the teachers; and on this point I may be pardoned expressing some satisfaction that most authorities seem now to concur in the opinion I have elsewhere stated, that the "teachers should be trained schoolmasters." "It is among the primary instructors" says M. Sluys, "that the recruiting of teachers for this work is to be done." And further, "The experiments of Basidow, Francke, and others in regard "to manual training—the educational bearing of which these teachers "well understood—have failed chiefly because the instruction in this "work was entrusted to *artisans*, who considered the school a workshop "and treated the pupils as *apprentices*."

It will be seen that there are several important questions connected with the hygienic value of manual training as a school exercise on which it is desirable to collect more exact information than we yet possess.

Information as to the results of manual training under various conditions will serve as a guide in framing rules for such instruction, with a stricter regard to its healthfulness than has yet been done. It is very desirable that accurate measurements should be made of the

i p. 2124.

children under instruction, so as to ascertain its effect in increasing muscular development. Records should be kept of the absences of children through illness, of their progress in other studies, and the results of these observations should be considered in connexion with the system of instruction adopted. In this way further guidance in directing the teaching on the best lines might be obtained. It must be remembered that manual training is yet, and is likely to remain for many years, a new subject. Its introduction into our schools marks an important change in our system of education. But it is still in its experimental stage. One of its chief advantages is to correct and mitigate the harmful results of that combination of circumstances, peculiar to the conditions under which the poorer classes have hitherto been educated, and known as "over-pressure." "In ordinary lessons," says M. Sluys, "pupils remain at their desks many hours. This sitting "position is bad; it enfeebles the body, and in this way reacts upon "the mind. Gymnastic exercise has its *raison d'être* in the need of "preserving the organic equilibrium. It increases the functional "energy, and through this the moral. Manual exercises if they are "properly chosen produce similar effects." That manual training may be made the means of developing the muscular strength, and of preserving and improving the health of the children in our elementary schools, there can no longer be any reasonable doubt; but it is important, for the intellectual as well as for the hygienic value of the instruction, that the best methods of training should be adopted, and such methods can only be secured by accurate observations and careful deductions. It is with the object of calling attention to the importance from a hygienic point of view of this new departure in our elementary education, that I have ventured to occupy the time of this Section with the consideration of a matter that has hitherto been regarded too exclusively from an industrial and economic standpoint.

DISCUSSION.

Dr. William Brown (New Zealand) said: A striking corroboration of the correctness of the views advanced by Sir Philip Magnus is afforded by what has been made a matter of reproach against the educational system of the present day. It has been said that the tendency of education is to make boys clerks, and girls sempstresses or shopkeepers. There has been in the past some reason for this. Sedentary habits contracted during school life tend to become stereotyped; and aptitudes in the use of pen and ink, which have been the activities cultivated during school life, determine the ambition and future of the children. Manual training and physical exercises will alter this for good.

Thursday, 13th August 1891.

The Chair was successively occupied by:—
The PRESIDENT;
Mons. TH. ROUSSEL;
Dr. KUBORN;
Dr. KOTELMANN;
Sir E. GALSWORTHY.

Neglected Children in our Towns and Cities.

BY

WILLIAM MITCHELL, Vice-Chairman of the School Board of Glasgow.

There are neglected children in every town and city of the United Kingdom.

There are neglected children in the charmed circle of the upper ten as well as in the poverty-stricken haunts of the submerged tenth.

My present paper is limited, however, by the programme to some consideration of the evils attending the latter class.

Of these, so far as numbers are concerned, it may be enough to say there are hundreds in every town, and thousands in every city.

It is scarcely necessary to describe them; they cannot be hid. One meets them at every turn.

Ill-clad, ill-fed, ill-conditioned, in alleys, in cellars, in lanes, in back-courts, in public thoroughfares—at markets, bazaars, and railway stations—selling papers and matches—dodging the bobby, jinking the "skill brod" officer—playing at pitch and toss, gambling at cards, touting for parcels to carry, and up to any mischief.

Certain groups rejoicing in the free-and-easy life of vagrant wanderers, others overburdened with premature care—neglect and sorrow written on every feature. Boys come most prominently into view, but girls share with them in every phase and variety of condition and circumstance.

As to their dwellings, they have all some corner called home, and every child of school age some parent or guardian who recognises responsibility. Let me glance at some of the so-called homes. Frequent reference has been made to the unprecedentedly large number of single room dwellings in Glasgow—numbering over 40,000. What that means when such single rooms are the abodes of a moderately sized family I leave you to judge. Take, for example, a room of 12 × 14, where reside father, mother, and half a dozen or more children of all ages. There may be two beds in the room, under which are hidden certain shakedown materials to be drawn out at night and laid on the floor.

In this single room the whole family board and lodge, cook their meals, perform their ablutions, dress and undress, while mothers, of course, attend to all the necessary claims of their young and infant children. The evil is too often aggravated by the admission of lodgers not belonging to the family.

Imagine, if you can, the state of such a room when morning dawns and the family begin, one after another, to rise from bed and floor. When visiting and well nigh suffocated in such dwellings during the day, I have often been constrained to cry "What of the night!" What of the night indeed? What of the horribly polluted atmosphere after a whole family have been immured for seven or eight hours in one of these small single rooms, mid all the fœtid vapours arising from damp and dirty clothing and from nameless impurities of various kinds.

All this is bad enough, but there is something still worse.

Where, let me ask, are the possibilities for decency, let alone purity and chastity, when boys and girls over twelve years of age are thus living together in a single apartment without even a screen or a curtain to separate them night or morning?

Such a state of things is not only a crying evil and dark blot on our boasted civilisation, but it is an open sore rendering social regeneration impossible while allowed to continue.

It may be asked how far it is possible to trace some of the causes which have led to the deplorable condition of neglected children both as regards their housing and as regards the pitiable condition in which they are so often found.

There are, as may be taken for granted, many orphans among them—many either fatherless or motherless—in many families the bread-winner laid aside by weakness or sickness—or the poor wife and mother deserted by an undutiful husband, who has gone off to other lands, a step so often and so easily taken at our shipping ports. In the greater number of such cases no parochial relief is granted, until at the point of starvation mother and children may be admitted into the poorhouse.

Such mothers for the most part prefer an honourable struggle that they may keep themselves and their children far from the poorhouse door; but what of the children while mother is thus engaged out of doors from early morning to late night?

Men who have lost their wives are not unfrequently in the same predicament, and the children, from want of parental control, are almost certain to grow into habits of carelessness, truancy, irregularity, or juvenile delinquency.

For these and similar cases where misfortune is the prime cause of neglect, only pity and help are due; but I need scarcely say that the chief causes for so many neglected children spring not so much from misfortune as from intemperance, thriftlessness, and misconduct on the part of parents.

Any attempt to arrange and formulate these causes, as they lead on to poverty, nakedness, wretchedness, degradation, and not unfrequently imprisonment, would leave me no time to speak of remedial measures, so I shall only add here that the prominent features of social degradation

are so bad, they can only be compared to a malarious jungle, where parasites choke all healthy growth, and poisonous exhalations deaden all sense of morality and even decency.

The object of this Congress is not so much to listen to descriptions, and to look upon the evils which surround certain classes of poor children, as to consider and discuss such remedies as will lessen or remove these evils.

The remedies may be described as legislative, social, or individual.

Of *legislative* measures which are desirable, let me take special note of one which might be framed to deal with one-room dwellings. Lest I should alarm the timid, let me say at once I am quite aware of circumstances where for suitable inmates a single room dwelling may be as healthy and happy an abode as a palace with countless apartments, and with such I have no desire to meddle, but I do wish Parliament to interfere with the present indecent and scandalous practice of a parent lodging his adult children, boys and girls, with himself and his wife, in a single apartment.

The Education Act declares it to be the duty of every parent to provide suitable education for his child, and enacts severe penalties in the event of failure. In similar terms I would suggest that a law be framed declaring that it shall be the duty of every parent to provide suitable and decent lodging for his children, and in no case shall girls over twelve years of age and boys over thirteen years of age, being of the same family, lodge with their parents in a single apartment. If, in such circumstances, the parent is unable from poverty to provide sufficient lodging, application may be made to some properly constituted authority, and it shall be the duty of the said authority to pay the additional sum required when satisfied of the inability of the parent.

Let it be understood once for all, and by all classes, that it is not only a shame, but a criminal offence for girls and boys over twelve years of age, of the same family, to lodge with their parents in the same apartment, and a deadly blow will be struck at a hydra of immorality and impurity which at present disgraces certain of the lower districts of our towns and cities.

In Glasgow the School Board have always recognised the close connexion between sanitation and education.

They did their best to aid the Town Council last year in procuring a Bill, giving the magistrates stringent powers to deal with insanitary dwellings, and enabling them summarily to shut up those which were considered uninhabitable.

The following sentences of the school board memorial made a marked impression on the Committee of the House who had the Bill under consideration :—

"The School Board are convinced that little improvement will be made in the character and condition of a very large number of children so long as they are housed and environed as at present. The Board are taken bound to find the most comfortable and sanitary school premises with 10 square feet of space for each child, separation of the sexes, latrines, lavatories, playgrounds, with every appliance for

their well-being. Does it not seem a mockery to make this ample provision for six to eight hours of the children's school day, with the knowledge that many of them are returning to wretched homes which have no title to the name, and where habits of cleanliness, decency, and morality can scarcely be maintained? It is the experience of the Board that, to a large extent, the surroundings and social circumstances of thousands of children are the main causes of the truancy, irregularity, vagrancy, and juvenile delinquency which the Board have so much cause to deplore. After the ample testimony which has so recently been borne on all sides to the insanitary and immoral condition of the housing of so many of the poor, the citizens are entitled to demand that the subject be trifled with no longer."

I am glad to say the Bill was made law, and its provisions have proved so effective that already certain wretched houses have been condemned and are being cleared away.

The question, however, regarding the scandal of grown-up children lodging together with their parents in a single room is one which is not local but national, and will never be settled until taken up by an outcry proceeding from the whole country.

Passing from this phase of the subject, let me say that the *social* remedial agencies which have been set on foot in our towns and cities in other directions, on behalf of neglected children, are very numerous and very valuable. Let me present a brief summary of such as exist in Glasgow apart from the ordinary reformatory and industrial schools which are common to all our towns and cities.

Poor children's dinner-tables are established in 13 districts, and are open to destitute children for eight months in the year.

The Medical Mission and other philanthropic agencies have stations in various districts, accessible without fee to all poor parents and children, and in many cases medicine is also given.

Day refuges have been established by a benevolent Christian Association where a number of poor children are fed, trained, and sent to Board Schools, returning home at night. The same society have done marvellously good work in connexion with the Children's Fresh-Air Fortnight.

The Day Industrial Schools, which have only had an existence of eight or ten years, are proving invaluable. They are specially suited for children whose mother being dead the father has no one at home to look after his young family, or, the father being dead, the poor widow is all day at work. They have also been found admirably suited for a certain class of neglected, badly-trained boys who have got beyond ordinary control, and over whom female influence has been found to have a marvellous effect. They are open from early morning to about seven at night, and the influence of the children for good, when they return to their own too often degraded homes, has been very marked. These schools are equipped for a certain amount of industrial work, and are well planned for supplying regular meals, for bathing and washing, for play and drill.

While not an advocate for removing children from home and family life, there are circumstances where this is absolutely necessary, and

Mr. Quarrier's Orphan Homes at Bridge-of-Weir have a world-wide reputation for the large number of orphan, neglected, or forsaken children rescued from misery and want.

The Society of St. Vincent de Paul should also be mentioned as doing excellent work in connexion with neglected and destitute children of Roman Catholic parents.

The Society for Prevention of Cruelty to Children has found, I am sorry to say, a prolific field for carrying on its benevolent and enterprising labours. It has been the means of ferreting out many very deplorable cases of neglect, destitution, and cruelty, and the knowledge of its existence has done much "to stay the plague." Since the recent Act was passed the streets are entirely cleared of children engaged in casual employment at untimeous hours.

There are always a large number of infirm among the neglected children of our towns and cities. About these I might have a good deal to say; but the consideration of their condition falls under a different section in the programme of the Congress.

Let it suffice for me to notice that an admirable institution for infirm children, called East Park Home, has been carrying on excellent work ever since the inquiries of the School Board, eighteen years ago, brought to light the fact that many such infirm children were lying in wretched homes uncared for and utterly neglected.

I have referred to remedial efforts as being not only legislative and social, but *individual.* You will easily understand how important a place this individual sphere occupies.

Agencies exist, but how often do these agencies languish and prove ineffective because neglected children are not brought into contact with them.

I do not desire new agencies, nor do I even plead at this stage for additional workers in connexion with them, nor for more generous support.

What is chiefly wanted is hearty recognition of such agencies—taking full advantage of them—bringing the children into touch with them—and it is here that individual effort comes in.

Let it not be supposed for a moment that I ignore what individual effort may do apart altogether from such agencies, in the way of rescuing and succouring neglected children. Much is being done in a voluntary and independent manner, and much more may be done; but it is not open to every one to expend the time and money which this involves; while it is open to every one who crosses the path of a neglected child to direct or lead that little one to the agency most suitable to its case—to the healing waters which are flowing specially for its benefit.

When Lord Nelson was asked for instructions on the eve of one of his most celebrated battles, his words were to the effect—"You cannot go wrong, Hardie, if every vessel lays itself alongside an enemy's ship." That should be the spirit of all individual effort—not waiting for instructions, nor hanging back for directions, but with the agencies, with the force at hand, bombarding existing evils and rescuing the children.

Before leaving the subject of remedial measures I wish to make reference to a Bill which has been for several years before the House of Commons, called the Movable Dwellings Bill. It has for one of its objects to bring under some measure of supervision the thousands of vagrant tinker children who, with their parents, are roving over the length and breadth of the country, no man caring either for their bodies or souls.

I can testify, from my own experience, that in certain rural districts they are growing up as ignorant as, and less cared for than, the cattle who graze beside them in the fields. The grossest intemperance prevails in their haunts, and the most absolute misery and degradation. Did time permit I could give most harrowing revelations.

Strange to say, this Bill has been blocked time after time by members who profess to see in it some interference with the liberty of the subject. Save me from such liberty! It is not liberty, it is the grossest licence.

In closing, let me say that the intrinsic value of neglected children is terribly overlooked. They are too often spoken of as "the residuum," as "waifs and strays," or as "gutter children." Such titles may be applicable in some degree to their outward appearance, but in no sense applies to the truest and best part of their nature. Every one of them is precious in the sight of God, and capable of being moulded and fashioned to reflect His image. Look at a little company of such children gathered, as I have seen them gathered, in a Day Industrial School, under the charge of an experienced female teacher. What possibilities for good are there! What capacities for development! A crust of reserve, and sometimes even duplicity, engendered by former adverse influences, may prevail for a time; but let the discipline, although firm, be gentle and forbearing, and the training kindly and intelligent, and soon the hard shell gets broken; and there may be found dispositions as sweet, abilities as excellent, and natures as genuine as in circles the most favoured.

How simply and artlessly they bear their hard lot. No word of complaint crosses their lips. Sadly and silently they carry their burden. In all the thousand cases which have come under my notice I cannot charge my memory with one where a poor child spoke complainingly or unkindly of father or mother. I may seem to speak of them in terms too glowing, but I firmly believe that when taken in time, e'er yet the plastic elements of childhood and youth have become hardened and vitiated, there is about such children a receptivity for teaching and training, and an appreciation of sympathy and kindness which is full of encouragement.

Let not the nation say "this is no affair of mine." "An Englishman's house is his castle;" "an Englishman's child is his own." "Away with all grandmotherly legislation and all pauperising of parents." Well, be it so, but do not forget that the children are there, whether you will or no. If left alone, neglect and vicious surroundings will all too soon canker and blight their prospects of future usefulness, and instead of fruitbearing trees they will be "pricks in your eyes and

thorns in your sides." Happy the nation which makes the care of her children one of her chief concerns—watches over their interests with an eye that never sleeps—succours them in distress—protects them from evil—fosters and promotes their highest well-being.

Des Progrés de la Diffusion de l'Instruction publique en Belgique, au point de vue de la Criminalité et de l'Aliénation mentale.

PAR

le Dr. Prof. Hyac. Kuborn.

I.

Criminalité.

Les hygiénistes, les moralistes, les criminalistes mêmes sont loin d'être d'accord sur le rôle que joue l'instruction dans les crimes, dans l'aliénation mentale et les suicides.

" A mesure que l'instruction s'est propagée d'année en année, le nombre des crimes et des délits s'est accru dans une proportion analogue. Les Départements (il s'agit de la France) où l'instruction est le plus répandue, sont ceux qui présentent le plus de crimes, c'est-à-dire que la moralité s'y trouve en degré inverse de l'instruction." (Michel.)

Je n'examinerai pas les procédés de statistique qui ont fait aboutir à d'aussi décevants résultats. Je n'en relèverai qu'un seul. On prend un chiffre déterminé d'accusés et l'on découvre que :

25,000 individus ayant reçu une instruction supérieure donnent plus de 15 accusés ;

25,000 sachant lire et écrire en donnent 6 ;

25,000 totalement illettrés, 5 seulement.

J'ai bien relevé aussi, pour la Belgique, en considérant une période de trente années — 1856 à 1885 — une décroissance régulière bien marquée de la criminalité dans le chiffre des accusés dénués de toute instruction, tandis que la proportion des individus sachant lire et écrire, ou ayant reçu une instruction supérieure, augmentait dans un parallélisme non moins régulier. Mais, et il n'en peut être autrement là où l'ignorance disparaît, je me suis gardé de tirer de ce fait une conclusion désolante. En effet, en posant le problème sur son véritable terrain, en prenant pour termes la mesure du développement de l'instruction dans une population pendant une série de périodes déterminées, d'une part ; et de l'autre, le chiffre des accusés pendant les périodes successives correspondantes, nous sommes arrivés à montrer, en quelque sorte, l'antagonisme existant entre la diffusion de l'instruction et la criminalité. Aux résultats des recherches de Michel, Guerry, Dangeville, etc., en France, on peut opposer ceux de Villermé, de Bertillon, de Gaillard. Villermé fait observer que les Départements où se trouvent le plus de propriétaires aisés, en même temps qu'une bonne instruction primaire, sont ceux qui fournissent le moins de crimes de toute espèce contre

les personnes et les propriétés. Plus encore : les tableaux de Bertillon et de Gaillard montrent que plus les hommes s'instruisent plus ils s'améliorent ; ainsi, avant 1830, on comptait 1 accusé *illettré* sur 3,180 habitants, 1 *lettré* sur 3,020—après 1846, on comptait 1 accusé *illettré* sur 2,460 habitants, 1 *lettré* sur 4,500.

Voici comment nous avons procédé dans nos recherches. Nous avons, dans une première partie, considéré, pour huit périodes successives, courant de 1832 à 1875, la proportion des habitants pour 1 accusé du chef de crimes capitaux ; et, de 1850 à 1885, celle des accusés de crimes en général, c'est-à-dire contre les personnes et les propriétés. Dans la seconde partie, nous avons réuni tous les éléments d'appréciation propres à permettre de mesurer le développement de l'instruction, en Belgique, en nous attachant spécialement à celle qui s'adresse à la masse, à l'instruction élémentaire, et en faisant correspondre ces données aux périodes envisagées pour la criminalité. Nous serons, dans ces considérations, aussi bref que les chiffres.

Nous devons à l'extrême obligeance de M. Lentz, directeur-général au Ministère de la Justice, les documents relatifs à la criminalité. Les chiffres qui concernent l'enseignement ont été puisés dans les Rapports sur l'état de l'ensignement inférieur et moyen ainsi que das les Archives du Ministère de l'instruction publique.

Il importe de faire ressortir les raisons spéciales qui nous ont déterminé à faire figurer à côté d'un premier tableau donnant le rapport de la population aux accusés de crimes en général, de 1850 à 1885, un second tableau dans lequel est relevée la proportion des crimes capitaux seulement, de 1836 à 1875. Ce procédé s'imposait à la rigueur des déductions que nous visions. En effet, le législateur de 1867 a soutrait à la compétence des cours d'assises un certain nombre de crimes, en sorte que, pour la comparaison stricte de la période de 1868 à 1875 aux périodes antérieures, il convenait de baser cette comparaison jusqu'en 1875 sur les crimes à l'égard desquels la législation est restée la même, tels que le meurtre, l'assassinat, l'empoisonnement, le parricide, l'infanticide.

Périodes.	Rapport moyen du Nombre des Accusés à la Population ou Nombre d'Habitants pour 1 Accusé de Crime *en general.* I.	Rapport moyen du Nombre des Accusés à la Population ou Nombre d'Habitants pour 1 Accusé de Crime *capital.* II.
1836 à 1839 -	- - - -	1 accusé pour 70,141 habitants
1840 à 1845 -	- - - -	„ „ 80,023 „
1846 à 1849 -	- - - -	„ „ 77,450 „
1850 à 1855 -	1 accusé pour 18,453 habitants	„ „ 90,228 „
1856 à 1860 -	„ „ 17,095 „	„ „ 97,536 „
1861 à 1867 -	„ „ 27,971 „	„ „ 115,514 „
Code pénal modifié.		
1868 à 1875 -	„ „ 37,339 „	„ „ 102,523 „
1876 à 1880 -	„ „ 34,563 „	——
1881 à 1885 -	„ „ 40,367 „	——

Quand on considère dans le tableau I, la marche de la criminalité générale de 1850 à 1885, on y voit une progression descendante très marquée, sauf pour la période de 1856 à 1860 qui accuse une légère augmentation sur la précédente, 4. Cet accroissement n'intéresse pas les crimes capitaux, car si l'on jette les yeux sur la période correspondante du tableau II, on verra qu'il ne porte pas sur les crimes les plus graves dont la diminution est restée constante.

Dans la période suivante la décroissance est considérable de part et d'autre.

Elle ne le paraît pas moins de 1868 à 1875, si l'on s'en rapporte au tableau I : 1 accusé de crime général pour 37,309 habitants au lieu de 1 pour 27,971. Mais il convient de faire observer qu'une partie de ce résultat doit être reportée à ce fait qu'un certain nombre de crimes justiciables des cours d'assises, ont été soustraits à la compétence de celles-ci par le législateur de 1867. C'est ce dont témoigne le tableau II, qui accuse une augmentation dans les crimes graves atteignant environ 6 °/₀. Mais si nous comparons, depuis la réforme du Code pénal, la période quinquennale aux deux précédentes, 1868 à 1875 et 1876 à 1880, nous voyons que le nombre des accusés jugés par les cours d'assises a de nouveau très sensiblement diminué. (Dans les provinces de Flandre occidentale, de Brabant et de Namur pour les crimes contre les propriétés particulièrement; dans celle de Luxembourg, pour les crimes contre les personnes; dans celles d'Anvers, de Hainaut et de Liège pour les crimes contre les personnes et les propriétés à la fois.)

Ajoutons enfin que de l'examen des six périodes qui divisent les 32 années de 1836 à 1867, il résulte que la proportion moyenne des accusés traduits annuellement devant les cours d'assises pour crimes capitaux, a constamment diminué, sauf dans la période de 1846–1849. Mais il est à noter que trois de ces quatre années, 1846, 1847, 1848, ont été marquées par une longue et forte crise industrielle et alimentaire.

Soit donc que l'on considère de 1850 à 1885 le rapport à la population des accusés de crimes généraux, soit de 1832 à 1875 celui des crimes capitaux, il se dégage de l'analyse à laquelle nous venons de nous livrer ce fait général d'une diminution progressive et, à très peu près constante, de la criminalité.

Les rapports différentiels qui marquent de part et d'autre entre elles les périodes successives considérées peuvent être établis dans les relations suivantes :—

—	1836 à 1839.	1840 à 1845.	1846 à 1849.	1850 à 1855.	1856 à 1860.	1861 à 1867.	1868 à 1875.	1876 à 1880.	1881 à 1885.
Crimes en général -	—	—	—	10·5	9·7	15·9	21·3	19·7	22·9
Crimes capitaux -	9·8	11·2	10·8	12·6	13·6	16	14·3	—	—

On voit les progrès réalisés lorsqu'on prend les extrêmes :—

Pour les crimes *capitaux*, de 1836 à 1839, *un* accusé sur 70,141 hab.
1868 à 1875 „ „ „ 102,523 „
„ „ *en général*, de 1850 à 1855 „ „ „ 18,452 „
de 1881 à 1885 „ „ 40,367 „

II.

Instruction.

Pour procéder avec rigueur dans la comparaison de la marche de la criminalité d'une part, de l'instruction de l'autre, nous devrons prendre notre point de départ à la période 1846 à 1849. Voici pourquoi.

Avant 16 ans il ne se commet que très exceptionnellement un crime. D'après les relevés de la justice criminelle de 1856 à 1875, on peut établir l'échelle suivante des âges :—

De 16 à 21 ans, 9 °/₀ d'accusés.
De 21 à 25 „ 14 °/₀ „
De 25 à 30 „ 21 °/₀ „
De 30 à 35 „ 15 °/₀ „
De 35 à 40 et de 40 à 45 ans, 11 °/₀ d'accusés.

Ce n'est guère qu'à partir de 16 ans qu'on commence à devenir criminel. Or l'organisation sérieuse et légale de l'enseignement élémentaire en Belgique a été inaugurée par la loi de 1842. Si nous considérons que l'enfant abandonne l'école primaire vers onze ou douze ans, nous voyons que l'influence de l'enseignement n'a pu commencer à faire sentir ses effets avant la période sus indiquée.

L'enseignement élémentaire se donne en Belgique dans des écoles primaires inférieures et primaires supérieures, dites moyennes; dans des écoles d'adultes ou primaires du soir. Les unes sont officielles, les autres adoptées et inspectées par l'administration publique; d'autres enfin sont libres, laïques ou religieuses.

Nous prendrons comme éléments d'appréciation, le nombre progressif des écoles et des élèves; les chiffres correspondants des dépenses; le degré d'instruction des jeunes gens appelés au tirage au sort et incorporés.

Années.	Écoles primaires des deux Sexes, communales, adoptées ou libres.				Écoles d'Adultes soumises à l'Inspection ou libres.	
	Nombre d'Écoles primaires.	Chiffres du Personnel enseignant.	Proportion d'Élèves par 100 habitants.	Dépenses réelles annuelles de toute nature pour l'Enseignement primaire.	Nombre d'Écoles d'Adultes.	Chiffre des Dépenses.
				Frs.		Frs.
1842	—	—	—	2,651,639	—	—
1844	—	—	—	3,142,286	—	—
1854	5,498	8,807	10·5	4,837,858	979	170,527
1860	5,558	9,222	10·9	6,783,340	1,145	181,129
1869	5,641	10,576	11·7	14,669,158	2,620	217,168
1875	5,857	11,863	12·4	19,320,017	2,615	204,673
	Les chiffres suivants n'intéressent plus que les écoles officielles ou adoptées, le gouvernement ayant cessé de recevoir des renseignements sur les écoles libres, laïques ou religieuses.					
				Frs.		Frs.
1881	4,726	8,328	340,118 élèves	32,598,206	2,445	—
1883	4,797	8,669	346,012 „	35,119,443	—	—
1885	5,474	10,667	588,804 „	29,480,647	1,648	64,348
1888	5,517	11,236	601,488 „	27,328,549	1,722	65,118
1889	5,634	11,550	614,671 „	—	—	—

Années.	Écoles primaires supérieures ou moyennes du Degré inférieur.		
	Garçons. Nombre d'élèves.	Filles. Nombre d'élèves.	Sommes allouées par l'État ou par les Communes.
			Frs.
1860	7,745 (y compris ceux de l'école moyenne de Bruxelles).	—	455,436
1870	9,308 (y compris ceux de l'école moyenne de Bruxelles et de Liège).	—	579,791
1875	10,962 - - -	(Non organisées encore)	772,035
1881	12,416 - - -	4,361 - - -	1,129,084
1888	13,325 (y compris les écoles communales ou adoptées).	7,049 (avec les élèves des écoles moyennes, communales ou adoptées).	2,957,941

De l'inspection de ces tableaux ressortent les déductions sommaires suivantes :—

En 1854, le nombre d'écoles primaires était de 5,498; en 1889, il s'élevait à 5,857. Les chiffres respectifs des membres du personnel enseignant, instituteurs et institutrices, furent de 8,807 et de 11,863. Les dépenses occasionnées par l'instruction élémentaire qui, en 1842, année de la promulgation de la loi, comportaient 2,651,639 frs., absorbaient, en 1875, la somme de 19,320,017 frs., et atteignaient, en 1888, celle de 27,328,549 frs. pour *les seules écoles officielles ou adoptées.* Je ne parle pas des années 1881 et 1883, pendant lesquelles ont été faites de fortes dépenses extraordinaires.

Quant aux écoles primaires supérieures, les sommes allouées par les pouvoirs publics, en 1860, se chiffraient par 455,436 frs. Cette somme s'élevait, en 1888, à près de 3,000,000. A la première époque, 7,745 élèves les fréquentaient; en 1888, elles en comptaient 20,404, dont 13,325 garçons, 7,079 filles, y compris les enfants des sections préparatoires, équivalant aux écoles primaires inférieures.

La statistique officielle nous apprend que déduction faite des enfants en dessous de 7 ans—soit près de 1 million de la population du Royaume—le nombre d'habitants sachant lire et écrire, s'élevant en 1866 à 2,279,090, atteignait, en 1880, le chiffre de 3,187,630. Ces deux données, mises en regard de la population en général, fournissent, pour 1866, la proportion de 58 °/₀; pour 1880, celle de 70 °/₀.

Mais pour bien préciser la progression marquée, continue et sans oscillation de la diffusion de l'instruction élémentaire en Belgique, nous ne pouvons prendre de meilleure base que celle du degré d'instruction, officiellement constaté, des jeunes gens incorporés dans l'armée à la suite du tirage au sort.

Années.	En 100 jeunes gens spécialement.				En 100 jeunes gens en général.	
	Sans instruction aucune.	Sachant lire et écrire imparfaitement.	Sachant bien lire et écrire.	Ayant un degré d'instruction plus élevé.	Ne sachant ni lire ni écrire.	Sachant *au moins* lire et écrire.
1843	43·61	7·24	26·34	22·81	50·85	49·15
1850	36·46	7·69	24·26	31·59	44·15	55·15
1860	31·83	7·58	27·68	32·91	39·41	60·59
1870	24·01	5·22	31·99	38·78	29·23	70·77
1875	19·24	4·23	40·56	35·97	23·23	76·53
1880	17·49	4·17	45·45	32·89	21·66	78·34
1881	15·99	3·34			19·33	80·67
1882	15·87	3·22	45·50	33·05	19·09	80·91
1883	15·38	3·12			18·49	81·51

De 1850 le chiffre des ignorants est tombé, en 1883, de 44·15 à 18·49.

Le chiffre des accusés devant les cours d'assises en 1850, tombe, en 1883, de 1 sur 18,453 à 1 sur 40,367.

Tels sont les points extrêmes des deux lignes, dont le tracé diagrammatique reproduit les points intermédiaires.

Il ne manque pas d'auteurs qui affirment que la civilisation augmente le nombre de fous; que l'aliénation mentale et la diversité de ses formes sont en raison directe du degré de civilisation d'un peuple. Prises dans un sens absolu, ces propositions sont fausses. On confond les accidents de la civilisation avec la civilisation elle-même. La civilisation n'a rien à voir dans nos émotions cherchées, dans les tripotages financiers, dans les catastrophes commerciales ou industrielles, dans l'alcoolisation d'un peuple. Nous n'avons pas à nous arrêter sur les éléments qui la constituent, n'ayant à envisager qu'un seul d'entre eux, l'instruction répandue dans les masses.

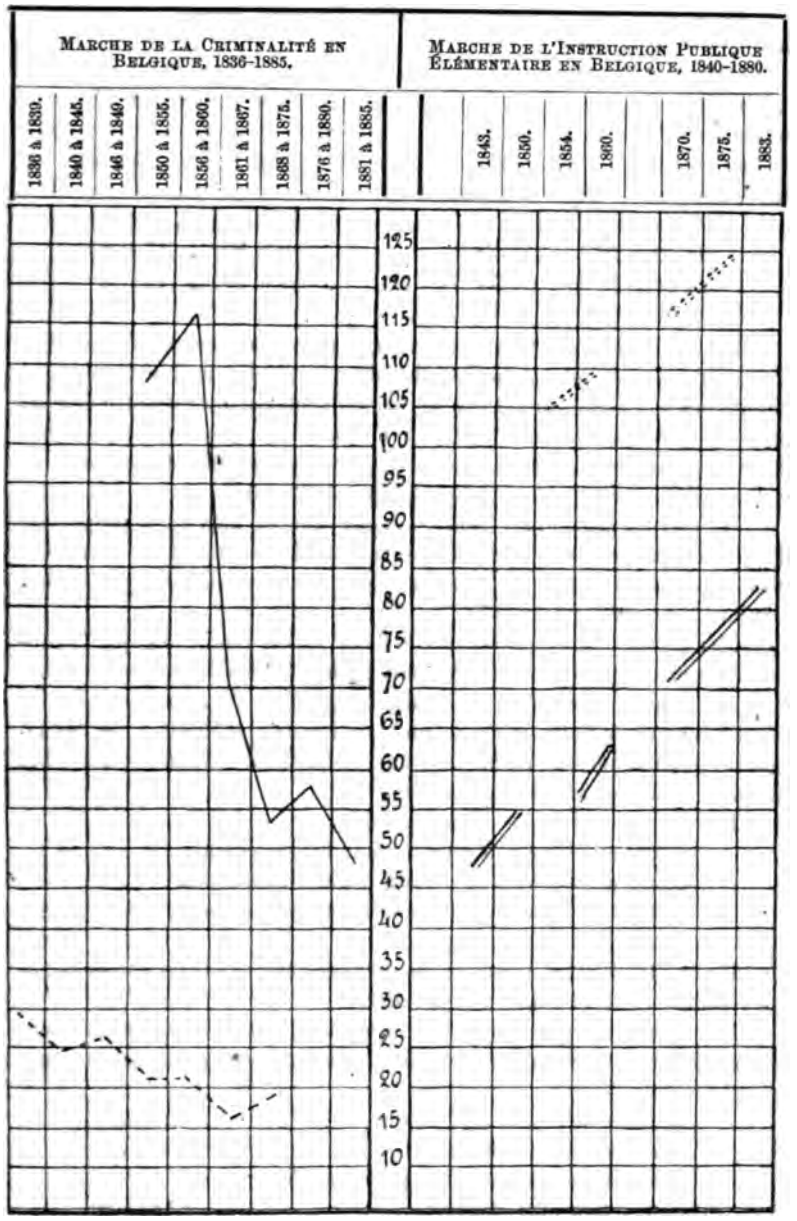
Il ne paraît pas, à première vue, que nous puissions appliquer, vis-à-vis de l'aliénation mentale, à l'avantage de l'instruction, les déductions auxquelles nous sommes arrivés en la mettant en regard de la criminalité.

1° De 1835 à 1878 l'aliénation mentale a suivi un mouvement ascendant en Belgique, une seule période exceptée :—

1835,	*un*	aliéné sur	816	habitants.	1858,	*un*	aliéné sur	714 habitants.
1842	„	„	727	„	1868	„	„	594 „
1853	„	„	920	„	1878	„	„	547 „

2° Les renseignements fournis sur les aliénés séquestrés dans les asiles, nous apprennent que le nombre des aliénés instruits est plus élevé que celui des illettrés : la proportion serait de 58·4 °/₀ des premiers, de 41·6 °/₀ des seconds.

3° Enfin parmi les aliénés des villes, on rencontre 62·4 °/₀ de lettrés, tandis que dans les campagnes ceux-ci n'entrent que dans la proportion de 55 °/₀.



Marche des crimes généraux rapportée à 2,000,000 population: ————

Marche des crimes capitaux rapportée à 2,000,000 population: - - - - - - -

Marche de l'instruction élémentaire rapportée à 10 °/₀ d'écoliers sur la population: : : : : : : : : : :

Marche du degré d'instruction des miliciens sachant lire et écrire en 100 jeunes gens appelés sous les drapeaux: ═══

Le premier point a toute la brutalité d'un fait acquis. Examinons la valeur du deuxième.

Si l'instruction entre pour une part dans les causes productrices de l'aliénation mentale, on doit rencontrer un fort contingent d'aliénés pendant ou dans les quelques années qui suivent la période des études à tous les degrés. D'après le chiffre de 10,020 aliénés recensés en 1878, nous avo s établi la gradation suivante :—

De moins de 10 ans,	5·3.	De 20 à 30 ans,	143·7.
De 10 à 20 „	38·3.	„ 40 à 50 „	174·4.
Au delà de 60 „	77·7.	„ 30 à 40 „	198·2.
De 50 à 60 „	130·7.		

Le Pr Guislain, de Gand, dans sa longue carrière de médecin et d'aliéniste, n'a pas pu constater au delà d'une trentaine de cas d'aliénation imputables aux seules préoccupations intellectuelles, intéressant d'ailleurs pour une forte part des étudiants au moment des épreuves de l'examen. Encore parmi eux s'en trouvait-il de prédisposés héréditairement ou victimes d'un surménage voulu plutôt que de l'étude.

Ne voit-on pas d'après notre tableau que la plus forte proportion d'aliénés appartient aux âges où les revers se produisent et se font le plus vivement sentir ; où les vices et les passions atteignent leur maximum de développement ?

Mais nous allons montrer directement qu'en bonne logique la proportion qui attribue le moindre contingent d'aliénés aux illettrés doit être renversée. Lorsqu'on veut faire la part de l'instruction dans le développement de l'aliénation mentale, il importe d'éliminer de l'équation les enfants âgés de moins de 7 ans, lesquels ne savent encore ni lire ni écrire ; puis les idiots de naissance.

Des 10,021 aliénés recensés en 1878 :

5,519 n'avaient pas reçu la moindre instruction ;
3,533 possédaient un certain degré d'instruction ;
824 avaien acquis une instruction plus élevée ou supérieure ;
145 n'ont pu être jugés.

Des 5,519 illettrés, doivent être déduits 1,501 idiots de naissance, ce qui réduit à 4,018 le chiffre des premiers

Maintenant la population du Royaume, d'après le recensement général de 1880, s'élevait à 5,520,009 habitants, se répartissant, d'après les calculs, en :—

Enfants de moins de 7 ans - -	966,228
Complètement illettrés - - -	1,306,127
Sachant lire et écrire ou pourvus d'une instruction plus complète - - -	3,187,630

Ces termes déterminés, les résultats sont ceux-ci :—

Aliénés absolument illettrés - - -	2·94
„ d'instruction plus ou moins complète -	1·54

Quant à la troisième proposition, à savoir que parmi les aliénés des villes on rencontre plus de lettrés, 62 °/o, que dans les campagnes, 55 °/o, nous ferons observer que l'écart est produit non seulement par le chiffer des lettrés proportionnellement plus élevé à la ville qu'à la campagne, mais par les agitations de la vie urbaine. Ainsi voit-on, au rapport

de Guislain, notamment, l'aliénation mentale moins fréquente dans la classe du clergé que parmi la population des villes. On en peut dire autant au profit de la classe des rentiers et des propriétaires. La raison de ce fait réside à la fois dans l'instruction des individus jointe à l'absence des agitations de l'esprit et des soucis de la vie.

Les causes les plus fréquentes de développement de l'aliénation mentale en Belgique n'ont rien à voir avec l'instruction. En première ligne se présente l'alcoolisme. De 1877 à 1881 inclus, la statistique relève que le nombre de sujets sortis guéris ou amendés des asiles est resté en proportion des entrées, tandis que celui des aliénés alcoolisés s'y est accru de 100, soit de 399 à 498. Viennent ensuite les chagrins de famille, les émotions vives, la jalousie, la haine, l'ambition, les amours contrariées, les déceptions de toute espèce, les excès de veilles, les remords de conscience, les péchés imaginaires, l'exaltation religieuse, etc.

Partout on voit dominer des penchants, des sentiments, des passions; mais non les lumières de l'intelligence.

La progression ascendante des suicides, en Belgique, n'est pas moins marquée que celle de l'aliénation mentale. Et ici encore, on a voulu établir un rapprochement avec le développement de l'instruction.

De 1866 à 1880 le nombre des suicides a gagné le taux de 157 par mille. En considérant deux périodes distantes de 15 années, 1850 à 1860 et 1876 à 1880, nous trouvons pour la première une moyenne annuelle de 3,036 suicides; pour la seconde, de 4,824 (*Statistique du Ministère de la Justice*). En mettant les chiffres bruts en rapport avec la population du Royaume (recensement général de 1856 d'une part, et les deux recensements généraux de 1876 et 1880 d'autre part), nous pouvons établir les deux proportions suivantes: de 1850 à 1860, suicides 0·67; de 1876 à 1880, *id.* 0·88.

Les deux périodes ci-dessus mentionnées comportent 5,448 suicides, dont les causes principales se répartissent ainsi (en 1,000) :—

Aliénation mentale, monomanie, délire, dérangement des facultés intellectuelles - - -	346
Chagrins domestiques - - -	94
Ivrognerie - - - - -	92
Chagrin et désespoir - - -	71
Misère, perte de fortune, d'emploi, dérangement d'affaires - - - -	48
Amour contrarié - - - - -	18
Débauche - - - - -	14
Causes diverses - - - - -	77
Causes non déterminées - - - -	240

Si l'on met à part les individus qui ont attenté à leur existence dans la folie, dans un accès d'ivresse, dans un paroxysme de douleur physique ou morale, dans un moment de suprême désespoir—suicides non prémédités—on ne se trouve plus en présence que de gens atteints de quelque émotion maladive, de quelque passion ou en proie à la

i p. 2124.

débauche. Ces états mêmes ne procèdent pas de l'instruction, mais de certaines conditions économiques, sociales ou d'une éducation faussée.

Loin de contribuer au développement du suicide, l'instruction est au contraire, lorsqu'elle est jointe à une saine éducation, le seul frein à opposer à nos tendances, à nos sentiments, à nos passions. Le suicide est de toute antiquité. On le retrouve chez toutes les nations, même chez les plus dénuées d'instruction, et cela avec une fréquence qui, à certaines périodes, atteignait et dépassait ce que nous voyons de nos jours.

Incriminer l'instruction et même la civilisation, autant vaut accuser d'être homicides la vapeur, par ce qu'elle fait explosion, l'électricité, par ce qu'elle foudroie.

The development of the Reformatory and Industrial School System in England.

BY

Colonel LENOX PRENDERGAST, J.P., Chairman of the Industrial Schools Committee of the London School Board.

Fifty years ago our criminal children were sent to the common gaols. They went in for their first faults, and came out familiar with evil. If the way in which a people treats its children is the measure of its civilisation, certainly our condition and instincts were not high.

About the year 1848, some individual efforts were made to introduce a system of farm-schools for the treatment of juvenile offenders, adopting and following out the plans and ideas of M. Demetz which were being carried out at Mettray in France, under the provision of the French peace code, by which offenders under 16 years of age are held to have acted "sans discernement," that is, without sufficient knowledge of right and wrong, and to require correctional training rather than penal treatment. The Mettray system meant faith in the power of kindness to win confidence, and of trust to create trustworthiness. The effort to work out the Mettray plans and principles upon an English footing received much encouragement from the countenance and assistance of one who always used his great position to further the well-being of our people. I allude to Prince Albert, the Prince Consort of the Queen.

The first awakening to a higher sense, produced the Reformatory Schools Acts. We had come to see, and statesmen had been found to promote legislation in order to provide, that even in treating criminal adults our penal system ought to be penitential; so much more in treating criminal children the system ought to be reformatory. The necessary Acts of Parliament having been passed, a department depending on the Home Office was formed, under which for long years Mr. Sydney Turner formed the outlines of our Reformatory School system.

That gentleman had for some years been working out the adoption of the Mettray system to this country's wants, and no one had greater practical experience to offer to a Government department dealing with what was after all a fresh departure in the treatment of juvenile crime. He was convinced, he tells us, that nothing has been more certainly demonstrated in the practical development of the reformatory system than that juvenile crime has comparatively little to do with any special depravity of the offender, and very much to do with parental neglect and bad example; he therefore utilised as far as possible schools which, while assisted and superintended by the State, are essentially conducted and controlled by voluntary management. This distinguishing feature of the English system he publicly stated, after an experience at the Home Office of 20 years, was in his opinion one of the keystones of its success.

Another and most important element of success must here be touched upon, and I shall use Mr. Sydney Turner's own words in describing how, in this department of education, what is called the religious difficulty has been dealt with in these schools under the Home Office to the satisfaction of all concerned. He says, "Reformatory "training is of necessity essentially based upon religious influences. "Little permanent impression can be made unless a sense of religious "duty is aroused, and religious affections awakened. Mere secular "instruction, and mere formal and dogmatic religious instruction, have "not much result. In many cases the young offenders who enter "reformatory schools have had a fair share of these, can read, write, "and cypher, and are familiar with the technical forms and expressions "of a catechism. They need to have the motives, feelings, and actions "of Christianity brought home to them in plain personal teaching, and "their interest in these awakened; and the teachers and superintendents "of the schools need to be at full liberty, as well as to have the personal "capacity and disposition, to do this as the occasion offers, without the "restrictions which the formal regulations of a time table, and the "cautionary provisions necessary for strictly public and rate-supported "institutions should impose. The provisions of both the Reformatory "and Industrial Schools Acts involve, indeed, that the schools be in a "certain degree denominational, as they secure for the children in "them, when desired, the instruction of ministers of their own "persuasion where they are not of the same religious denomination as "that to which the school belongs, and the conditions imposed in the "rules approved by the Secretary of State protect the children from "being taught or required to learn the distinctive formula of any section "of the Christian church but that to which they or their parents belong; "but the voluntary element in the management of the schools has "effectually removed any practical difficulty, combining men of various "views and denominations on their committees, ensuring freedom of "religious teaching, and keeping this essentially to the plain founda-"tions of practical scriptural instruction in the Protestant schools, and "allowing the Roman Catholic children, who form so large a proportion "of the inmates, to be provided with schools appropriate to themselves,

" and instructed fully in the requirements of their own church." And the present Inspector of Reformatory and Industrial Schools more recently corroborates Mr. Turner's views. He says, " The great element " of success in those schools is without doubt the combination of " voluntary managing committees and Government supervision and " support." " Religious education goes hand-in-hand with secular in " all our schools, as it always must do if real reformation is aimed at. " Roman Catholic children are generally sent to schools of their own " persuasion, but where they are committed to schools under Protestant " management it is always insisted on that their own clergymen shall " have access to them at stated times, and in schools where there are any " number of Catholic children one of the under-masters is always a " Catholic."

The number of reformatory schools at the beginning was small. It steadily increased, as the benefit of the treatment was tested and proved by the steady diminution of committals of children for breaches of the law, as is shown in the returns year by year: for instance, in 1861 there were committed to prison in England 7,373 boys and 1,428 girls, total 8,801; in 1890 the return shows 3,456 boys and 416 girls, total 3,872.

The reformatory schools having at last been established, it soon became evident that such an institution, with all it wise mitigations, was after all a penal system, and the poor children committed by magistrates for trifling thefts were marked for life with a stigma.

To remedy this the Industrial Schools Acts were passed, and the wise mercy of this further mitigation has become manifest every year. No stigma attaches to a child carefully brought up in an industrial school. They were not really responsible for their childish offences. The vices, or negligence, or cruelty of their parents, were the original cause of their faults.

The State, then, having awakened to a sense of its duty towards the neglected portion of the juvenile population, and having provided machinery by which institutions were forthcoming for the reception of the children, a further impulse to the beneficent work was given in the years 1870 and 1876 by provision in the Elementary Education Acts of those years for school boards to carry out The Industrial Schools Acts of 1866. This was effected by constituting them the " local authority " within their districts, under the misleading title of " Prison authority "; and, as soon as they have formally assumed the position thus given to them under the Acts, they may (1) contribute to the maintenance of children sent at their instance to voluntary industrial schools, (2) may contribute towards the cost of the establishment, or the alteration, enlargement, or rebuilding of voluntary industrial schools, (3) may establish industrial schools of their own.

They are also empowered to appoint officers to bring children before a magistrate in order to their being sent to an industrial school.

Reformatory and Industrial Schools are essentially distinct in character, and governed by distinct Acts of Parliament; a school cannot at the same time be both a certified industrial school and a certified

reformatory school. The county industrial schools, formerly maintained by the magistrates, by recent enactments have become institutions under the county councils.

The Treasury contributes towards the custody and maintenance of offenders in reformatory, and of children in industrial, schools on the recommendation of the Secretary of State; but the contribution is so small that, unless a local authority makes up the amount to 7*s*. a week, justice cannot be done to the children, and it is optional with that authority to undertake the necessary duty. It was only after the working of Education Acts had revealed the importance of dealing with this class of children in the great towns, that an impetus was given to gathering these children into the schools according to the provisions of the Industrial Schools Acts. The School Board for London, shortly after its creation, assumed the duties thus conferred by these Acts of Parliament, and when we consider that the population of the Metropolitan area exceeds that of the whole of Scotland, their working of the Acts may be considered a good sample of what is being done generally to carry out these Acts.

The following are the classes of children sent to industrial schools:—

	Section XIV.	Section XV.	Section XVI.
Age.	Under 14.	Under 12.	Under 14.
Description of Offence.	1. Begging or receiving alms. 2. Found wandering, and not having any home or settled place of abode, or proper guardianship, or visible means of subsistence. 3. Found destitute, either being an orphan, or having a surviving parent undergoing penal servitude. 4. Frequenting the company of reputed thieves.	Where the child is charged with an offence punishable by imprisonment, but has not been convicted of felony.	Where the parent or step-parent represents that he is unable to control the child, and that he desires that the child be sent to an industrial school.

By the provisions of the Industrial Schools Acts Amendment Act, 1880, there are added to the above descriptions of children liable to be sent to industrial schools under Section XIV. of the Industrial Schools Act, 1866, the following descriptions, namely:—

Lodging, living, or residing with common or reputed prostitutes, or in a house resided in or frequented by prostitutes for the purpose of prostitution.

Frequenting the company of prostitutes.

A child may also be sent to an industrial school under Section 12 of the "Elementary Education Act of 1876," where an attendance order has not been complied with, and where the parent satisfies the Court that he has used all reasonable efforts to compel the child to attend school.

Children sent by the School Board for London to Industrial Schools.—Children sent during twelve months ended Lady-day, 1890. —The following table shows the number of children sent to industrial schools under sections of the Industrial Schools Acts and of the Elementary Education Act of 1876, during the twelve months ended Lady-day, 1890:—

Industrial Schools Act, 1866.		Industrial Schools Acts Amendment Act, 1880.	Elementary Education Act, 1876.	Total.
Sections XIV.—XV.	Section XVI.			
529	59	18	336	942

These figures include the children sent to Board industrial schools, as well as to schools under voluntary management.

Children sent since 1871.—The following table shows, for each calendar year since 1871 to 1886 inclusive, for the fifteen months ended 25th March 1888, and for the years ended 25th March 1889 and 1890, the number of children who have been sent under the above-named sections:—

Year.	Industrial Schools Act, 1866.		Industrial Schools Acts Amendment Act, 1880.	Elementary Education Act, 1876.		Total.
	Sections XIV.—XV.	Section XVI.		Section XII., following upon XI. (1).	Section XII., following upon XI. (2).	
1871 - - - -	176	4	—	—	—	180
1872 - - -	287	22	—	—	—	309
1873 - - - -	527	138	—	—	—	665
1874 - - -	442	154	—	—	—	596
1875 - - - -	422	286	—	—	—	708
1876 - - -	510	288	—	—	—	798
1877 - - - -	573	199	—	6	2	780
1878 - - -	519	170	—	54	2	745
1879 - - - -	491	129	—	244	1	865
1880 - - -	386	68	—	239	—	693
1881 - - - -	417	59	7	315	1	799
1882 - - -	341	75	7	240	10	673
1883 - - - -	447	97	50	279	14	887
1884 - - -	397	74	47	238	2	758
1885 - - - -	369	50	28	508	—	955
1886 - - -	388	52	7	525	1	973
15 months ended 25th March 1888.	520	68	16	541	11	1,156
Year ended 25th March 1889.	527	71	11	450	—	1,059
Do. 1890 - -	529	59	18	336	—	942
Totals - -	8,268	2,063	191	3,975	44	14,541

Industrial Schools Act, 1866:—		
Sections XIV. and XV. - - -	8,268 —	
Section XVI. - - - - -	2,063 —	10,331
Industrial Schools Acts Amendment Act, 1880:—		
Section I. - - - -	—	191
Elementary Education Act, 1876:—		
Section XII., following upon Section XI. (1)	3,975 —	
Section XII., following upon Section XI. (2)	44 —	4,019
Grand total - - -		14,541

Of this total number there remained in the schools at Lady-day last 2,619 children.

In addition to the 14,541 cases which have been sent to industrial schools at the instance of the Board, the Committee have inquired into 14,245 further cases, which have been mainly disposed of as follow:—Some were sent to industrial schools, irrespectively of the Board; some were referred to parish authorities, some were referred to the Reformatory and Refuge Union, and some were referred to the Divisional Committees of the Board for action under the byelaws or the Elementary Education Act of 1876, &c.

Contributions to Voluntary Industrial Schools (Maintenance).—Before the Board send a child to a school under voluntary management, there must be an arrangement with the managers of the school. The Board have agreements with 38 industrial schools for boys, and with 21 industrial schools for girls in various parts of the country.

[A copy of the usual form of agreement is given in the Appendix.]

The following table shows the scale of payments made to the voluntary industrial schools for the various classes of children. Briefly, it may be stated that, as a general rule, the Board contribution supplements the Treasury contribution, so as to make a total grant to the school of 7*s.* per child per week, except in the cases of training ships where the total grant is made up to a sum of 8*s.* per week per child:—

—	Board Contributions.					Treasury Contributions.				
	Industrial Schools Act, 1866.			Elementary Education Act, 1876.		Industrial Schools Act, 1866.			Elementary Education Act, 1876.	
	XIV.	XV.	XVI.	XI.(1)	XI.(2)	XIV.	XV.	XVI.	XI.(1)	XI.(2)
	s. d.	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*
Age 6 to 10 - -	4 0	4 0	5 0	5 0	3 6	3 0	3 0	2 0	2 0	3 6
„ 10 „ 15 - -	3 6†	3 6†	5 0	5 0	3 6	3 6*	3 6*	2 0	2 0	3 6
Over 15 - - -	3 6†	3 6†	5 0	5 0	3 6	3 6*	3 6*	2 0	2 0	3 6
„ having completed 4 years of detention.	4 0	4 0	5 0	5 0	3 6	3 0	3 0	2 0	2 0	3 6

* In cases of schools certified before 1872, this amount is 5*s.*
† In cases of schools certified before 1872, this amount is 2*s.*

Contributions to Voluntary Industrial Schools (Buildings).—During the earlier years of the Board it, was found that the number of places available in voluntary industrial schools was insufficient. The Board accordingly took advantage of the power to contribute towards the establishment, alteration, or enlargement of voluntary industrial schools, so as to secure places to which children might, at their instance, be sent by the magistrates. The total amount so contributed has been 8,450*l.* to 12 schools, with the result that, at present, 720 places are reserved for the Board.

Industrial Schools under the Management of the Board.—The Board have established three industrial schools, namely:—

(*a*) The school at Brentwood, Essex; (*b*) the training ship "Shaftesbury," lying off Grays, Essex; (*c*) the two schools at Upton House, Urswick Road, Homerton, and at Highbury.

The Brentwood Industrial School.—This school is certified for 100 Protestant boys.

The following are the particulars of the annual cost per head for the year ended on the 25th March 1890:—

Average number maintained, 102:		£	s.	d.
Annual cost per head, including salaries	Gross	28	19	10¾
" " "	Nett	22	7	1
Average weekly cost for provisions	Officers	0	10	7½
" " "	Boys	0	2	7¼

The corresponding figures for the previous year were as follow:—

Average number maintained, 102:		£	s.	d.
Annual cost per head, including salaries	Gross	25	16	4
" " "	Nett	17	7	9½
Average weekly cost for provisions	Officers	0	10	6
" " "	Boys	0	2	3¾

The above figures show an increase in the annual gross cost per head of 3*l.* 3*s.* 6¾*d.*, and in the nett cost per head of 4*l.* 19*s.* 3½*d.*

The "Shaftesbury" Ship.—This ship is certified for 500 boys (of which number 100 may be Roman Catholics), who must be between the ages of 12 and 14 on admission.

The following are the particulars of the annual cost per head for the year ended on the 25th March 1890:—

Average number maintained, 395:		£	s.	d.
Annual cost per head, including salaries	Gross	28	3	10¼
" "	Nett	19	18	2¼
Average weekly cost for provisions	Officers	0	11	2½
" "	Boys	0	3	1¾

The corresponding figures for the previous year were as follow:—

Average number maintained, 345:		£	s.	d.
Annual cost per head, including salaries	Gross	26	9	9¾
" " "	Nett	18	11	3
Average weekly cost for provisions	Officers	0	10	1
" " "	Boys	0	2	5¼

The annual gross cost has increased by 1*l.* 14*s.* 0½*d.* per head, and the nett cost by 1*l.* 6*s.* 11¼*d.* per head.

Similar details in regard to truant schools will be given when we come to treat of cases dealt with under the Education Act.

Having got the children into the schools, the important duty then follows, not only of instructing them, but also of providing means for putting them out in life. Industrial training, which is so prominent a feature in these schools, enabled the inmates to get a start, and a homeless, friendless lad with such capital at his disposal, was able somewhat to hold his own in competition with the general population. The extension, however, of technical instruction in the elementary schools of the country cannot but interfere to some extent with the necessary duty of placing out these children; and it has been the object of recent legislation, though it is not yet in practical operation, to enable those answerable for these institutions to emigrate and to apprentice the children on whom so much time and care has been expended.

The mercantile marine, which should take many of the boys on board the training ships, has of recent years, owing to the decline in the shipping trade, the substitution of donkey engines on board sailing ships for hand labour in hauling ropes and the like, become an uncertain source of disposing of the lads. And the recent labour troubles contribute not a little to the difficulty, since amongst the workmen there is a jealousy of boy-labour as lowering the rate of wages, to say nothing of the desire so prevalent amongst them, that none but members of the union should be taken on in the workshops and on board the ships.

Truant-schools, being of comparatively recent introduction, it may, perhaps, be well to describe somewhat in detail the circumstances that have brought them into existence.

We have seen the class of children who are inmates of reformatory and ordinary industrial schools, and both contemplate a permanent separation of the child from its old haunts. Mere truancy may be the result of want of sufficient control in a respectable home, and, if dealt with early enough, may be cured by a temporary sojourn under strict authority.

The Elementary Education Act of 1876 gave power to send a child to an industrial school for non-attendance at school, and one section of it empowers the managers of industrial schools to license children so sent to live out of such schools after a short detention, not less than a month, conditionally on the children so licensed attending certified efficient schools as day scholars. A special class of industrial schools for the temporary treatment of boys away from their homes has come into existence in several of the large towns of England; and, as my own experience is confined to London, the remarks now made would refer chiefly to what is being done in London for the child population belonging to the elementary schools generally, and not to board schools only.

In London we have two truant-schools located in buildings specially constructed for the purpose and fitted with all recent improvements. They are buildings of the first class. Owing to the short period of detention contemplated in these schools, and to the constant and

strict supervision consequently required, a large staff has to be maintained in them. Three hours daily are given to school work; efforts are made to interest the boys in their lessons, and to cause them to be as little irksome as possible by making the schoolroom the most cheerful room in the house. The lessons are of a very elementary character; the children from their previous irregular attendance at school, being necessarily very backward. An hour and a half is allowed for recreation, and the time not otherwise occupied in drill. The boys are taken on Sundays to the nearest church (the Roman Catholics to their own place of worship under the charge of an assistant schoolmaster of their own faith), and they are allowed a walk once a week beyond the precincts of the school. The average cost of food per week is 2*s.* 4*d.* for each boy. On admission, each child is provided with a plain working suit, his own clothes being meanwhile fumigated, and, as far as possible, mended and put aside, to be resumed on quitting the school. The schools are under the management of the Industrial Schools Committee of the Board; and in describing this part of the work, I am using the words of Mrs. Westlake. who brought the experience of years on these matters to assist in starting the experiment of these schools, which are now so successful.

The Upton House Truant School has been established to enable the Board to deal with cases of truant boys. Formerly 112 boys could be received; but a separate infirmary having been provided, the rooms in the main building which were used as an infirmary are now used as ordinary dormitories. The school has consequently been certified for 140 boys. The age of admission is between 6 and 14, and the school is generally quite full.

The plan adopted by the Board for dealing with the truants is as follows:—Boys are sent to truant schools by the magistrates, generally until they shall arrive at the age of 16 years, but in some cases for short periods only, viz., for six weeks, or for two, three, or four months. The usual course, when the term of detention is for a sufficiently long period, is to license the child out, at the expiration of about ten weeks, on condition that he attends a certified efficient school regularly. It then becomes the duty of the teacher of the school at which he attends to send a post card to the Head Office on every Friday afternoon, giving particulars of the boy's attendances. If his attendances continue to be perfectly satisfactory for a period of nine months, application is made to the Home Secretary that the boy may be discharged. If, however, the teacher's report shows that the boy has not attended regularly, an officer is at once sent to visit the boy's home, and to warn the parents that if the boy does not attend with perfect regularity the license will be revoked. In many cases this warning is effectual. But should the boy continue to be irregular in his attendance, his license is revoked, and he is taken back to the school. On this occasion his period of detention extends to about three months, after which the boy is again licensed out. If his license is revoked a second time, his next period of detention is still longer. Boys are usually cured of their habits of truancy without any necessity for the revocation of their licenses; but

if, as happens in a few cases, three or four revocations of a boy's license are ineffective, an application is made for the boy's discharge, and fresh proceedings are taken in order that he may be sent by a magistrate to an ordinary industrial school. Originally the Home Secretary was in the habit of agreeing to the *transfer* of such cases—a plan which acted most satisfactorily—but latterly applications for the transfer of boys from truant schools to ordinary industrial schools have been declined, probably to curtail the number of children in industrial schools.

The subsequent attendance of the boys who have undergone the discipline of truant schools, bears very strong testimony to the efficacy of the system in curing truancy. The average attendances of the boys licensed out, for the calendar years 1879 to 1886, inclusive, for the 15 months from the 1st January 1887 to the 25th March 1888, and for the years ended 25th March 1889 and 1890, are as follow :—

1879	88·80 per cent.
1880	84·07 „
1881	91·73 „
1882	90·97 „
1883	90·96 „
1884	74·80 „
1885	95·19 „
1886	94·27 „
15 months end 25th March 1888	91·61 „
Year ended 25th March 1889	88·94 „
Year ended 25th March 1890	91·60 „

Not only are the children that have been through these schools the most regular, but the testimony of the teachers is that they are among the most attentive and the best behaved. The testimony of the parents is equally strong, and their gratitude is often great that their children have been rescued from a path which would have inevitably led to ruin, to be trained up as good and useful citizens by dealing with their delinquency early in life.

The experimental truant school, established at Upton House, having been rebuilt and re-arranged in February 1885, it may be interesting to note the statistics from that date to March 1891.

Total number admitted	1,985
Total number licensed out after an average absence from home of 10 weeks	1,894
Total number of cases in which the license has been revoked	616
Licensed out the second time	577
Second license revoked	226
Licensed out for the third time	208
Third license revoked	92
Licensed out for the fourth time	80
Fourth license revoked	22
Licensed out for the fifth time	17

Fifth license revoked - - -	5
Licensed out for the sixth time - - -	3
Transferred to other schools - - -	8
Discharged - - - -	1,459
Total number remaining in the school - -	138
Licensed out and never re-admitted - -	1,246
	(or nearly 63 per cent.)

The percentage of average attendance compared with the average number on the roll in the public elementary schools of London at Lady-day 1890 was 78. Boys on license, however, from this truant school attend on an average over 90 per cent. !

These figures speak for themselves as to the effect produced on the children brought under the system I have been describing. To those accustomed to the freedom of the streets, the irksomeness of being confined and watched is very great, and they will make a real effort to escape from a renewed experience of what is to them so unpleasant. The thorough daily cleansing of their bodies, the regular food and sleep, little ailments attended to by the medical officer of the school, all these, with constant occupation and discipline, act as an alterative, and, short as the period of detention is, it partakes of the nature of a fresh start for those brought under this altogether new influence.

There are two distinct systems of management at present in existence in truant schools. A third system, based on one which obtains in some of the foreign schools, in which strict and enforced silence forms the leading feature, was proposed some years ago by the London School Board, but did not receive the sanction of the Home Office; it need not, therefore, be alluded to now.

In some of the truant schools of England the treatment is similar to that in an ordinary industrial school, but the detention is rendered more irksome by the substitution, to a great extent, of drill for play. In other schools a system has been approved of by the Home Office in which solitary confinement for a short period after admission forms the principal feature. This lasts only a few days. The boys attend school with the others, but, except when so employed and at exercise, are confined in separate light cells in which they are supplied with work and in which they sleep. The first of these schemes, says the inspector of industrial schools, whose words I am quoting, is the one which I prefer. Solitary confinement works unequally in different boys. The School Board for London, after long experience, finds the best plan is to avoid solitary confinement altogether.

It is not possible to pass by an important addition to the Industrial Schools Acts which was made in the year 1880, for the purpose of dealing with a peculiar class of children whose existence was brought to light as soon as the compulsory powers of the Education Acts came thoroughly to be worked. In explaining the matter to those who are sufficiently interested in child-life to come here on this occasion, I shall use the description (in the very words, if I can) of one of my

colleagues, a lady with whom I have worked for a dozen years at the Industrial Schools Committee, over which I have now the honour to preside in London. Miss Davenport-Hill, whose knowledge of industrial schools generally, and of the working of the Acts which govern them, is greater than that of any one I know, had occasion soon after this amendment Act became law to address a public audience on the subject. She showed that there existed amongst us children who were *growing up* to a life of vice, and that till 1880 the law was powerless to rescue them. The existence of this class, brought to light by the action of the school boards, whose business it was to ascertain what children there were of school age, even in houses of ill-fame, was unknown to the framers of the Industrial Schools Acts as originally framed; consequently no provision was then made for their protection.

The greater number of these children are girls who, unfortunately for themselves and for the nation at large, have a marketable value, and are taken into the abodes of vice with a view to future profit. Some of them, mere infants at entrance, are no more than children, and quite unable to protect themselves. To deal with this evil, the Parliament of this country passed the necessary Bill, for once, without talk, and in a few hours it passed through both houses, and became law. To Colonel Claude Alexander, now Sir Claude Alexander, Bart., a friend of my own, belongs the distinguished honour of producing by his Bill this important though small addition to the legislation for the protection of defenceless children.

The schools that have been established already are chiefly under the management of devoted ladies, who labour personally to set right what is wrong, and to lay the foundations of respectable life not only for the worst cases but for others who, strange to say, have come unscathed out of the demoralizing home. The keepers of these houses in which children have been found dwelling, who fear and hate the interference of public authority, very often send their children away from home, placing them where they are well cared for and sent regularly to school. This cause is sometimes the result of good motives, sometimes, of bad ones. Some keepers really desire that their children should grow up to be respectable members of society, others again wish their daughters, as soon as they are old enough, to follow their parents' detestable trade; but, whichever cause is at work, it is essential to keep those at bay who administer the Industrial Schools Amendment Act of 1880. How far what has just been said is the cause is unknown, but certainly the number of girls' schools for the purposes of this particular Amendment Act has not been required to be increased so much as might have been anticipated. Of course the large proportion of the expense must fall on the public. Parents are, it is true, called upon to contribute, but their contributions will not suffice. At first sight it seems hard that the severely-taxed ratepayers should be called upon to support the children of parents who wilfully neglect them. But a moment's reflection will show that in all relations of life the innocent suffer for the guilty. A little further reflection will show

that expense incurred now will diminish future expense, or even entirely obviate it. No class is so costly to the public as that of prostitutes, and to reduce their number is true economy, without regard to the infinitely more important moral side of the question.

All of us who have taken any part in the management of industrial schools know, to our cost, that there are parents who are willing to part with their children as long as they are a burden; but are anxious to reclaim them when they are valuable. Recent legislation is directed against this evil. Its provisions will not form the slightest bar to intercourse between parents and children, wherever the former sincerely desire the welfare of their offspring; but it will protect the young people from those wretched men and women, not deserving the name of fathers and mothers, who are so utterly degraded themselves that, for the sake of the money their children can bring in, would drag them down to their own miserable level!

In 1876 a fresh class of industrial schools was introduced, called "certified day industrial schools," in relation to which "prison authorities" and school boards have the same powers as in the case of industrial schools, notwithstanding that the children do not reside on the premises. Towards the custody, industrial training, elementary education, and meals of the children attending these schools, Parliament may contribute a sum of 1*s*. per head per week on conditions recommended by the Secretary of State, with a limited power over the contributions of parents. The advocates of this class of schools consider that there are great advantages for poor neglected children of the large cities in sending them to these schools. Within the jurisdiction of the School Board for London, to which my own personal experience is confined, the operation of this provision of the Acts has not yet come into use. I cannot, therefore, speak definitely on the subject. Hitherto the aim of the Board has been, where it meddled with the population, to do what it had to do thoroughly. It will be observed by those conversant with the Industrial Schools Act, that the establishment of schools of this character is a fresh departure; for in all the other classes of schools which we have been considering, the application of the system has been to the individual child. In day industrial schools, areas of population are dealt with, and no child living at a greater distance than two miles from the school can be sent to it.

These schools, at present, are conducted on the system called "mixed," that is, for both boys and girls, and they are administered by women teachers. They differ from ordinary industrial schools in that, though they provide meals for the children and detain them from early morning till six in the evening, they do not lodge the children, and lose all control of them during the 12 hours of the night. They were authorised only by the Education Act of 1876, and, therefore, can be established only in England; and they are regulated by that Act, by Orders in Council, and by orders and regulations for their governance made by the Secretary of State.

In bringing these remarks to a conclusion, I should like to allude to what the Poor Law has been doing towards dealing with the juvenile population. Of course, theoretically, the children in their vast residential schools are supposed to stand on a higher platform than those gathered into industrial schools. Poverty only may be the supposed claim for the admittance of the children into pauper schools; but, practically, the shade of difference is scarcely appreciable, and the question is whether some means cannot be found to admit some of the children with whom the "local authority" has to deal to Poor Law residential schools, when the circumstances of the family point to this as their proper destination.

Time does not admit of pursuing this in detail on the present occasion, nor is it strictly within my instructions to deal with Poor Law questions at all; but I cannot resist expressing a hope that something may bring about some closer inter-communion between these Government Departments presided over by the Home Secretary and the President of the Local Government Board.

As matters stand at present, there are a number of industrial schools which have been brought into existence within the last 20 years, a period which has also witnessed an immense development of the organised treatment of children in the pauper schools. As far as the industrial schools are concerned, they are, individually, in a high state of efficiency, to which they have been gradually brought by the fostering care, the wise forbearance, and sympathetic action of the inspectors of reformatory and industrial schools; but admirable as the schools are, each school is itself, and no more. There is no tie which binds them with others engaged in similar work. They are like a series of excellent and efficient regiments that belong to no brigade, and have not heard of any division of their army with which to be in contact. If the poor residuum of the population of this country is to be raised out of the condition into which it is fallen, this can only be done by dealing directly and at once with those who, in a few years, will be of the adult army of paupers. If a fraction of the 2,000,000*l.* per annum about to be expended in abolishing the fees hitherto contributed by parents for the education of their children in elementary schools were spent in a prompt effort to utilise the industrial school system so as to stamp out the miserable condition into which the population has fallen, the effect on the coming generation would speedily be felt by the community at large.

An offender under 16, convicted of an offence punishable with penal servitude or imprisonment, and sentenced to be imprisoned for 10 days, or for a longer term, may be sent to a certified reformatory school for not less than two, and not more than five, years. A youthful offender under 10 cannot be sent to a reformatory school unless he has been previously charged with some crime or offence punishable with penal servitude or imprisonment, or is sentenced by a judge of assize or court of general or quarter sessions.

Both reformatory and industrial schools are certified by the Home Secretary upon the application of the managers who provide site,

buildings, and administrative cost, and upon satisfactory inspection and report, and subject to periodical visitation by inspectors. In both classes industrial training is an essential feature, so as to engender industrious habits in the inmates, and to give them the means of earning an honest livelihood. Not only local circumstances but reasonable individual inclinations are taken into consideration. In rural districts the cultivation of the soil, and in urban districts local trades, are obvious sources of employment. The duties of a sailor are taught in training ships near the coast.

In Great Britain there are—

55 reformatory schools.
141 industrial schools.
19 day industrial schools.

Cost of Reformatory Schools.			Cost of Industrial Schools.		
Year.	Inmates.	Cost.	Year.	Inmates.	Cost.
		£			£
1859	3,276	72,893	1866	2,462	58,701
1890	5,854	119,336	1890	22,735	360,947

The reformatory school, as the first ground of action when dealing with juvenile delinquents, may be pronounced to be an encouraging success, in that it took them at an early age before they had advanced very far in crime. These schools are not on the increase; on the contrary they may be said to be on the decline: for the great mischief of *mixing* up bad and good, young and old in the reformatory school, led to the establishment of preventive or industrial schools, and the gradual substitution of the industrial and comparatively innocent school for the reformatory school. In the same direction has followed the truant school, raising up an agency for correcting and saving from further contamination and ruin many misguided and foolish lads who in many cases only need a little wholesome discipline and correction to bring them to their senses, and put them straight in the way which they were ready to desert for a career of wilfulness and vicious action.

So in our large manufacturing towns, where families are congregated in factories, much good has been effected by the day industrial school, by taking the vagrant, starving, and neglected children out of the streets and placing them in well-appointed schools where three meals are given every day but Sunday, and wholesome instruction and training are provided. The female influence and authority in these schools is said to be powerful for good with this class of children.

All these efforts seem to follow logically on the first permanent attempt to deal with the young who were going on unchecked and uncared-for in their ignorance and perversity.

These schools *in all their varieties* have been working most beneficially for the last few years; it took time to build them up, but their influence has been really felt. They have let in an immense light upon the whole criminal question and have had a large measure of encouraging success. They would have a still greater share of success if the community at large would take a greater interest in their development and results, and help the managers to place out the children in situations when they are ready for service. "The people" themselves should assist in this important duty, for they more often know of opportunities of employment than persons living in a different sphere of life. All may contribute to prevent young children growing up in vice and misery by some strenuous efforts to save them and utilise them as good citizens.

I have endeavoured within the time at my disposal to give a general survey of what has been attempted in this country to deal with the question of the treatment of juvenile delinquency, and in doing so I have not hesitated to make frequent use of the words of others who may have equal or greater experience of the subject than I possess myself. As a rule, the knowledge of this subject is confined to a few experts, and I would fain enlist a more general sympathy with a work the object of which is, by a more refined treatment, to efface the stigma of the law which up to a recent period pressed so heavily on our poor children.

The mind, and will, and character of a neglected and off-cast child, surrounded day and night with evil, have both a natural and an acquired proneness to evil.

We were rearing children to breaches of the law so long as they were running wild in the streets without the teaching and the discipline of a school. My endeavour in this paper has been to draw attention to what is being done to bring about a better state of things.

APPENDIX.

Appendix VII.

INDUSTRIAL SCHOOLS COMMITTEE.

Copy of usual Form of Agreement with the Managers of Voluntary Industrial Schools.

Articles of Agreement made this day of A.D. 18 between the managers of the being a certified industrial school, under the Industrial Schools Act, 1886 (herein-after called the school), for themselves and their successors in the management of the said school of the one part, and the School Board for London (herein-after called the board) of the other part.

1. On the first day of every calendar month the managers shall notify in writing to the clerk of the board the number of children of between six and 15 years of age whom they will receive into the school, if sent thereto by a magistrate at the instance of the board during the calendar month thence next ensuing, and the managers hereby agree to receive that or any smaller number of children if so sent to the school at the instance of the board within the said month, and the reception by the managers of any such child shall be deemed to be an undertaking by them with regard to that child in accordance with the 18th section of the said Act.

2. The board undertake to pay to the managers (at the times hereinafter mentioned), in respect of each child so sent to the school as aforesaid, during the period of his detention therein, or until the withdrawal or resignation of the certificate of the school takes effect, or until the contribution out of money provided by Parliament towards the custody and maintenance of children detained in the school is discontinued (whichever shall first happen), such a sum of money per week, as will, with the sum of money which shall from time to time be contributed per week by the commissioners of Her Majesty's Treasury in respect of the same child, make up the total sum of 7*s.* per week. And the managers undertake to pay to the board any sum or sums of money which shall from time to time be paid to them by the said commissioners in respect of the same child, under the provisions of the 40th section of the said Act.

3. The board also undertake to pay to the managers the sum of 3*l.* towards the management of the school, in respect of each child received by the managers under this agreement within three months after such child shall have left the school. Provided always that if such child shall not have been by the managers placed in some situation, or otherwise disposed of, to the satisfaction of the board, then the managers shall forfeit all claim to the said sum of 3*l.*

4. The managers shall make up their accounts against the board in a form to be supplied by the board, up to the end of the months of February, May, August, and November, and shall deliver the same to the board before the 8th day of the respective following months, and the board shall pay the amount, which shall be due from them, within 21 days after the due delivery of each account in manner aforesaid.

5. The managers shall not permit any child sent to the school under this agreement to lodge out of the school, in accordance with the provisions of the 26th section of the Act, or to live out of the school under license, in accordance with the provisions of the 27th section, without the consent first obtained of the board, or of some committee or officer of the board duly authorised in that behalf.

6. The managers shall, once in every year of our Lord, send to the board a report in writing (in a form to be supplied by the board) stating such particulars with regard to each of the said children, as the board shall from time to time require.

7. If a child shall have been discharged from, or shall have left the school, the particulars of the discharge from, or cause and manner of leaving the school, and how he has been disposed of, shall be sent to the board by the managers on the next succeeding day on which the notification mentioned in clause 1, is to be given.

8. The board shall be at liberty to appoint an inspector of the children, and such inspector may visit the school and examine the said children at all reasonable times in the daytime.

9. It shall be a sufficient reason for the refusal of the managers to receive any child so sent to the school as aforesaid, that such child is suffering from a contagious or incurable disease, or from such a bodily or mental defect as will prevent him from earning his own livelihood, and the certificate in writing of a surgeon appointed by the managers,

shall be sufficient evidence that the bodily or mental condition of the child is such as is stated in the certificate.

10. In this agreement female children are included wherever male children are mentioned.

In witness whereof this agreement has been signed by the clerk of the School Board for London, acting under a resolution of the board passed at a meeting held on the day of and by two of the managers of the said school, acting under a resolution of the managers passed at a meeting held on the day of

Managers of

Clerk of the School Board for London.

Cost of the Department.—The following table gives the total cost of the Industrial Schools Department of the London School Board, for the years ended on the 25th March 1888, 25th March 1889, and 25th March 1890 respectively :—

	Year ended 25th March 1888.		Year ended 25th March 1889.		Year ended 25th March 1890.	
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
(i.) Maintenance of children in Schools under voluntary management	17,252 12 1		13,158 2 11		17,239 5 6	
Salaries of officers	751 11 2		779 11 10		770 7 11	
Advertising, travelling, and other expenses	319 5 11		343 3 7		350 12 0	
*Proportion of salaries of head office staff from 29th Sept. 1887	408 19 6		813 18 4		906 19 9	
		18,732 8 8		15,094 16 8		19,267 5 2
(ii.) Management of the Board Industrial Schools— Brentwood	2,619 19 2		2,326 13 3		2,598 17 2	
"Shaftesbury"	9,659 19 9		9,109 10 4		11,110 2 8	
Upton House	2,417 7 10		2,517 15 6		2,602 14 7	
Do. Furniture for new building	Nil.		95 1 5		63 10 2	
		14,697 6 9		14,049 0 6		16,375 4 7
		33,429 15 5		29,143 17 2		35,642 9 9

* This expenditure was included up to the 29th Sept. 1887, in the ordinary head office expenses, but, in accordance with the arrangements since made by the Board, an apportioned amount of the general office expenditure has been included in this year's statement.

RETURN respecting Reformatory and Industrial School Ships from 1886 to 1890, inclusive.

ENGLAND AND WALES.

Name of Ship and Captain; also Name of Tender, if any; distinguishing Reformatory Ships from Industrial.	Where Stationed.	Number of Boys committed to each Ship in each Year.			Number of Boys Discharged from each Ship in each Year, and Average Time under Training.	How disposed of.				Number Physically Unfitted for Sea Life of those received on board annually.	Number of Boys which each Ship can accommodate for Training.	Number of Boys borne in each Ship on 31st December, 1890.	Number and Nature of Staff on Board each Ship for Purposes of Instruction, exclusive of Captain; Status or Rank of Second in Command, if any; distinguishing Seamen Instructors from Civilian.
			Under 12 Years.	Over 12 Years.		To Sea.	Army.	To Shore Situations.	Emigrated.				
"CORNWALL."													
Reformatory School Ship	Purfleet, Essex.	1886	—	89	101	58	6	30	1	6	250	204	1 chief officer, Lieutenant G. Gordon, R.N.
Captain A. Morrell, R.N.		1887	—	91	113	58	1	52	—	2			2 schoolmasters.
Ship's launch used as practice for training.		1888	—	83	77	46	—	26	—	5			1 chief seamen instructor.
		1889	—	66	67	36	4	26	—	1			6 seamen instructors.
		1890	—	67	99	63	2	29	—	5			1 bandmaster.
					Average 2 years and 9 months								1 cook. 2 carpenters. 1 clerk.
Totals - -	- - -	—	—	396	457	261	13	163	1	19	250	204	15 {8 seamen. 7 civilians.
"AKBAR."													
Reformatory School Ship	Rock Ferry, Liverpool.	1886	—	54	34	16	2	7	1	2	200	172	1 chief officer, chief boatswain, R.N.
Commander E. Hicks, R.N.		1887	—	46	59	37	—	14	—	—			6 seamen instructors.
No Tender.		1888	—	50	55	25	—	14	—	4			1 chaplain.
		1889	—	74	48	29	1	12	—	2			2 schoolmasters.
		1890	—	52	35	21	1	10	—	2			1 master tailor.
					Average, 3 years.								1 cook. 1 carpenter.
Totals - -	- - -	—	—	276	231	128	4	57	1	10	200	172	13 {7 seamen. 6 civilians.

Return respecting Reformatory and Industrial School Ships from 1886 to 1890, inclusive—England and Wales—*continued.*

Name of Ship and Captain; also Name of Tender, if any; distinguishing Reformatory Ships from Industrial.	Where Stationed.	Number of Boys committed to each Ship in each Year.			Number of Boys Discharged from each Ship in each Year and Average Time under Training.	How disposed of.				Number Physically unfitted for Sea Life of those received on board annually.	Number of Boys which each Ship can accommodate for training.	Number of Boys borne in each Ship on 31st December, 1890.	Number and Nature of Staff on Board each Ship for Purposes of Instruction, exclusive of Captain; Status or Rank of Second in Command, if any; distinguishing Seamen Instructors from Civilian.
			Under 12 Years.	Over 12 Years.		To Sea.	Army.	To Shore Situations.	Emigrated.				
"CLARENCE."													
Reformatory School Ship	New Ferry, near Liverpool.	1886	2	45	56	27	—	29	—	5	300	184	1 chief officer, retired boatswain, R.N.
Commander E. P. Statham, R.N.		1887	5	63	60	45	—	15	—	1			8 seamen instructors (naval pensioners).
		1888	1	67	36	25	—	11	—	2			2 schoolmasters (civilians).
		1889	2	50	59	47	—	11	1	2			
		1890	3	31	50	44	—	5	1	1			
					Average, 3 years and 6 months.								
Totals		—	13	256	261	188	—	71	2	11	300	184	11 { 9 seamen. 2 civilians.
"CLIO."													
Industrial School Ship	Off Garth Ferry, Menai Straits, Bangor, North Wales.	1886	—	74	76	47	—	29	—	—	280 but only licensed for 250.	234 committed, 31 voluntary.	1 chief officer, quartermaster, R.N.
Captain W. M. Moger, R.N.		1887	—	70	96	55	—	41	—	1			7 seamen instructors.
		1888	—	78	59	31	—	28	—				1 gunnery instructor.
		1889	—	79	65	36	—	29	—	1			3 schoolmasters.
No Tender.		1890	—	55	68	42	—	26	—	4			2 carpenters.
													1 cook.
													1 clerk.
					Average, 3 years and 3 months.								1 shoemaker.
													1 sick ward attendant.
													1 night watchman.
													1 Liverpool shipping agent.
Totals		—	—	356	364	211	—	153*	—	11	280	265	20 { 9 seamen. 11 civilians.

* Forty-two of these since gone to sea.

Return respecting Reformatory and Industrial School Ships from 1886 to 1890, inclusive—England and Wales—*continued*.

Name of Ship and Captain; also Name of Tender, if any; distinguishing Reformatory Ships from Industrial.	Where Stationed.	Number of Boys committed to each Ship in each Year.			Number of Boys Discharged from each Ship in each Year, and Average Time under Training.	How disposed of.				Number Physically Unfitted for Sea Life of those received on board annually.	Number of Boys which each Ship can accommodate for Training.	Number of Boys borne in each Ship on 31st December, 1890.	Number and Nature of Staff on Board each Ship for Purposes of Instruction, exclusive of Captain; Status or Rank of Second in Command, if any; distinguishing Seamen Instructors from Civilian.
			Under 12 Years.	Over 12 Years.		To Sea.	Army.	To Shore Situations.	Emigrated.				
"MOUNT EDGCUMBE."													
Industrial School Ship -	Saltash, River Tamar.	1886	1	78	62	23	13	—	—	3	250	202	1 chief officer, gunner, R.N. 3 seamen instructors. 1 gunnery instructor. 2 schoolmasters. 1 carpenter. 1 tailor. 1 shoemaker. 1 cook. 1 bandmaster.
Captain H. P. Knevitt, R.N.		1887	4	55	91	20	11	—	4	2			
		1888	3	61	83	18	7	—	5	5			
		1889	3	84	64	18	3	—	7	—			
No Tender.		1890	2	64	62 Average, 2 years and 9 months.	21	1	2	5	2			
Totals - -	- - -	—	13	342	362	100	35	2	21	12	250	202	12 {5 seamen. 7 civilians.
"WELLESLEY."													
Industrial School Ship -	North Shields, River Tyne.	1886	35	24	69	56	2	1	—	—	300	296	1 chief officer. 1 second officer. 3 seamen instructors. 1 gunnery instructor. 1 men's schoolmaster. 3 assistants. 1 tailor. 1 shoemaker. 1 bandmaster. 1 band serjeant.
Commander H. C. D. Ryder, R. N.		1887	45	33	83	64	—	1	—	—			
		1888	49	51	85	58	3	8	—	—			
		1889	28	45	74	57	2	9	—	—			
		1890	16	66	81 Average, 3 years.	54	—	14	—	—			
Totals - -	- - -	—	173	219	392	289	7	33	—	—	300	296	14 {6 seamen. 8 civilians.

Return respecting Reformatory and Industrial School Ships from 1866 to 1890, inclusive—England and Wales *—continued.*

Name of Ship and Captain; also Name of Tender, if any; distinguishing Reformatory Ships from Industrial.	Where Stationed.	Number of Boys committed to each Ship in each Year. Under 12 Years.		Over 12 Years.	Number of Boys Discharged from each Ship in each Year, and Average Time under Training.	How disposed of. To Sea.	Army.	To Shore Situations.	Emigrated.	Number Physically Unfitted for Sea Life of those received on board annually.	Number of Boys which each Ship can accommodate for Training.	Number of Boys borne in each Ship on 31st December, 1890.	Number and Nature of Staff on Board each Ship for Purposes of Instruction, exclusive of Captain; Status or Rank of Second in Command, if any; distinguishing Seamen Instructors from Civilian.
"SHAFTESBURY."													
Industrial School Ship - Lieutenant D. Scriven, R.N. Captain Superintendent. Tender, Schooner "Themis."	Grays, River Thames, Essex.	1886	—	116	187	85	10	14	1	1	500	400	1 chief officer, petty officer, R.N. 5 seamen instructors. 5 schoolmasters. 1 bandmaster. 1 mechanic. 1 tailor. 1 carpenter. 1 cook. 1 shoemaker.
		1887	—	126	164	71	12	11	—	2			
		1888	—	141	126	48	5	7	—	3			
		1889	—	147	99	40	4	5	—	—			
		1890	—	143	138 Average, 3 years.	72	9	6	—	—			
Totals - -	- - -	—	—	673	714	316	39	43	1	6	500	400	17 { 6 seamen. 11 civilians.
"FORMIDABLE."													
Industrial School Ship - Captain R. B. Nicholetts, R.N. Tender, "Polly."	Portishead, Somerset	1886	55	51	96	59	—	14	7	9	350	342	1 chief officer, gunner's mate, R.N. 8 seamen instructors. 5 schoolmasters. 1 tailor. 1 shoemaker. 1 carpenter. 1 cook.
		1887	40	45	111	80	—	16	1	11			
		1888	48	54	87	64	—	14	1	4			
		1889	60	56	109	77	—	20	1	6			
		1890	43	61	112 Average, 3½ years.	87	—	15	1	6			
Totals - -	- - -	—	246	267	515	367	—	79	11	36	350	342	18 { 9 seamen. 9 civilians.

Return respecting Reformatory and Industrial School Ships from 1886 to 1890, inclusive—England and Wales—*continued.*

Name of Ship and Captain; also Name of Tender, if any; distinguishing Reformatory Ships from Industrial.	Where Stationed.		Number of Boys committed to each Ship in each Year: Under 12 Years.	Number of Boys committed to each Ship in each Year: Over 12 Years.	Number of Boys Discharged from each Ship in each Year, and Average Time under Training.	How disposed of: To Sea.	How disposed of: Army.	How disposed of: To Shore Situations.	How disposed of: Emigrated.	Number Physically Unfitted for Sea Life of those received on Board annually.	Number of Boys which each Ship can Accommodate for Training.	Number of Boys borne in each Ship on 31st December 1890.	Number and Nature of Staff on Board each Ship for purposes of Instruction, exclusive of Captain; Status or Rank of Second in Command, if any; distinguishing Seamen Instructors from Civilians.
"SOUTHAMPTON."													1 chief officer.
Industrial School Ship -	Hull, River Humber.	1886	23	30	63	30	—	31	—	2			1 2nd officer.
		1887	24	30	65	28	—	33	1	3			4 seamen instructors.
Rear-Admiral George D. Broad, R.N., Captain Superintendent.		1888	32	30	73	49	—	22	—	2	250	237	2 schoolmasters.
		1889	41	38	61	34	—	26	—	1			1 bandmaster.
		1890	36	37	66	29	1	34	—	2			1 shoemaker.
					Average, 4 years.								2 tailors.
Tender, "Ripple."													1 carpenter.
													1 cook.
Totals - -	- - -	—	156	165	328	170	1	146	1	10	250	237	14 { 6 seamen. 8 civilians.

C. B. Stuart-Wortley.

SCOTLAND.

Name of Ship and Captain; also Name of Tender, if any; distinguishing Reformatory Ships from Industrial.	Where Stationed.		Number of Boys committed to each Ship in each Year: Under 12 Years.	Number of Boys committed to each Ship in each Year: Over 12 Years.	Number of Boys Discharged from each Ship in each Year, and Average Time under Training.	How disposed of: To Sea.	How disposed of: Army.	How disposed of: To Shore Situations.	How disposed of: Emigrated.	Number Physically Unfitted for Sea Life of those received on Board annually.	Number of Boys which each Ship can Accommodate for Training.	Number of Boys borne in each Ship on 31st December 1890.	Number and Nature of Staff on Board each Ship for purposes of Instruction, exclusive of Captain; Status or Rank of Second in Command, if any; distinguishing Seamen Instructors from Civilians.
"EMPRESS."													1 chief officer, lieutenant, R.N.
Industrial School Ship -	Gareloch, River Clyde, off Row, N.B.	1886	29	94	125	76	1	1	1	5			1 chief gunner, R.N.
													6 seamen instructors.
Commander G. S. Deverell, R.N.		1887	29	105	142	92	2	3	4	1			4 schoolmasters.
													1 bandmaster.
		1888	38	102	118	85	4	7	1	4	400	392	1 assistant bandmaster.
Tender, "Cumbria," Brig.													1 tailor.
		1889	32	73	125	93	1	12	1	4			1 mechanic.
													1 carpenter.
		1890	58	86	131	78	3	5	1	8			1 master-at-arms.
					Average, 3¼ years.								2 night watchmen.
													1 shipping agent.
													1 hospital attendant.
Totals - -	- - -	—	186	460	641	424	11	28	8	22	400	392	22 { 8 seamen. 14 civilians.

Name of Ship and Captain; also Name of Tender, if any; distinguishing Reformatory Ships from Industrial.	Where Stationed.	Number of Boys committed to each Ship in each Year.			Number of Boys Discharged from each Ship in each Year, and Average Time under Training.	How disposed of.				Number Physically Unfitted for Sea Life of those received on Board annually.	Number of Boys which each Ship can Accommodate for Training.	Number of Boys borne in each Ship on 31st December 1890.	Number and Nature of Staff on Board each Ship for purposes of Instruction, exclusive of Captain; Status or Rank of Second in Command, if any; distinguishing Seamen Instructors from Civilians.
			Under 12 Years.	Over 12 Years.		To Sea.	Army.	To Shore Situations.	Emigrated.				
"MARS."													1 chief officer, 1st class petty officer, R.N. 5 seamen instructors. 1 master-at-arms. 1 merchant seamen. 4 schoolmasters. 1 gymnastic instructor. 2 carpenters. 2 tailors. 1 shoemaker. 1 bandmaster. 1 cook. 1 officers' steward. 1 shore gardener. 1 mechanic. 1 sick attendant.
Industrial School Ship -	Dundee, River Tay, N.B.	1886	27	118	123	64	8	46	1	3			
Commander C. C. Scott, R.N.		1887	18	89	111	38	3	61	5	4			
		1888	36	102	137	69	2	61	1	2	400	399	
Tender, "Francis Molison," Brig.		1889	29	92	132	49	7	68	6	2			
		1890	35	107	134	72	10	40	—	6			
					Average, 3 years.								
TOTALS - -	- - -	—	145	508	637	292	30	276	13	17	400	399	24 { 8 seamen. 16 civilians.

W. INGLIS.

IRELAND.

"GRAMPIAN."													Staff, 14 in number. Second in command, master mariner. Seamen instructors, 3, naval pensnrs. Gunnery instructor, 1, naval pensr. Tailor instructor, 1, civilian. Shoemaker instructor, 1, civilian. Carpenter instructor, 1, civilian. Schoolmaster, 1, civilian. Assistant schoolmaster, 1, civilian. Bandmaster instructor, 1, army pensr. Clerk and Storekeeper, 1, naval pensr. Cook, 1, naval pensioner. Engineer, 1, civilian.
Industrial School - -	Belfast Lough, Ireland.	1886	35	19	67	10	—	36	1	16			
Captain E. F. Kerby, R.N.		1887	25	20	70	16	3	31	—	11			
		1888	51	19	52	6	1	28	—	22	350	250	
No Tender.		1889	45	26	57	8	—	31	2	15			
		1890	50	23	56	8	—	29	1	15			
					Average, 4 to 5 years.								
TOTALS - -	- - -	—	206	107	302	48	4	155	4	79	350	250	

ROWLAND BLENNERHASSETT.

Reformatory and Industrial Schools Act, 1891.

[54 & 55 Vict. Ch. 23.]

CHAPTER 23.

An Act to assist the Managers of Reformatory and Industrial Schools in advantageously launching into useful Careers the Children under their Charge. 3rd July 1891.

BE it enacted by the Queen's most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:

Power to apprentice or dispose of Child.

1. If any youthful offender or child detained in or placed out on license from a certified reformatory or industrial school conducts himself well, the managers of the school may, with his own consent, apprentice him to, or dispose of him in, any trade, calling, or service, or by emigration, notwithstanding that his period of detention has not expired, and such apprenticing or disposition shall be as valid as if the managers were his parents.

Provided that where he is to be disposed of by emigration, and in any case unless he has been detained for twelve months, the consent of the Secretary of State shall also be required for the exercise of any power under this section.

Short Title and Extent of Act.

2. This Act may be cited as the Reformatory and Industrial Schools Act, 1891, and it shall not apply to Ireland.

L'Enfant à Tendances Criminelles ou placé dans un Milieu Criminel.

PAR

THÉOPHILE ROUSSEL, Sénateur, PARIS.

L'examen de la question posée sous le titre "*l'Enfant dans des conditions anormales*" m'a conduit, pour l'enfant pauvre, non perverti et dont la famille est honnête, a cette conclusion : que le meilleur régime est la vie de famille où des secours doivent être donnés ; que, si la famille manque ou ne peut garder l'enfant, le meilleur régime est celui du placement dans une autre famille honnête où il est maintenu dans les conditions de la vie commune.

L'examen de la seconde partie de la question aboutit, au contraire, a cette conclusion : que les enfants à tendances criminelles ou placés dans un milieu criminel, ont besoin d'une éducation spéciale et séparée, et même qu'ils doivent être exclus de la vie commune, lorsqu'il est bien constaté qu'ils lui sont impropres.

Le Programme du Congrès pose la question de "*leur éducation* "*dans les Écoles industrielles ou de réforme, et des effets de la loi de* " 1880; *amendant la loi sur les Écoles industrielles.*"

Ces termes visent uniquement, comme on le voit, les institutions anglaises. On ne saurait s'en plaindre, car la Grande Bretagne avec ses *Écoles de Réforme* et ses *Écoles industrielles*, possède aujourd'hui tant pour *l'Éducation correctionnelle* que pour *l'Éducation préventive*, le systême le plus complet et le plus satisfaisant par ses résultats.

Les progrès de la criminalité dans le jeune âge, devenus effrayants, chez les peuples les plus civilisés, ont nécessité partout des mesures particulières de préservation sociale. A une époque où ce péril social était encore peu senti, la France avait fait un pas remarquable par le vote de la *loi du 5 août*, 1850, *sur l'éducation et le patronage des jeunes détenus*, et la création des *colonies agricoles*. Les principes de cette loi furent bientôt adoptés partout, et l'Angleterre créa les *Reformatories* pour ses jeunes délinquants; mais elle ne s'en est pas tenue là. Adoptant un autre modèle que l'État de New-York lui offrait, depuis 1853, pour les enfants non encore délinquants ou criminels, mais disposés à le devenir par les conditions de leur existence, elle créa, en 1857, *l'École industrielle*, établissement destiné à prévenir l'action de la justice répressive, plustôt qu'à organiser la répression. Les deux *Acts* mémorables du 10 août, 1866, ont fait de ces institutions un systême à l'aide duquel la société anglaise se considère aujourd'hui comme armée efficacement pour arrêter les progrès du crime dans ses jeunes générations. Lorsqu'en 1880, les pouvoirs publics ont jugé bon d'amender ces lois, le Ministre de l'Intérieur d'alors, Sir William Harcourt, a reconnu le bien fondé de cette affirmation, souvent répétée depuis, que "l'école industrielle a arrêté le développement de la criminalité juvénile en Angleterre."

Si l'on cherche quel est, dans les institutions dont je parle, le fait particulier auquel ces succès peuvent être attribués, on reconnaît que ce n'est pas à un apprentisage industriel spécial, mais au pouvoir de détenir les enfants, tout le temps nécessaire à leur éducation, non obstant leurs parents ou tuteurs. L'école industrielle est un établissement d'éducation et d'apprentisage avec droit de garde et de correction sur les enfants qu'elle reçoit.

Ce qu'on reprochait surtout aux lois de 1866, c'était d'avoir admis des classifications défectueuses qui amenaient en pratique, une sorte de pêle-mêle des enfants. Au Congrès international de Stockholm, en 1878, avant la nouvelle loi d'amendement, ce reproche était repoussé par deux hommes très compétents, M. Alfred Hill et le Dr. Mouat, qui soutinrent que les seuls coupables étaient placés régulièrement dans les *Reformatories* tandis que les vagabonds étaient reçus dans les Écoles Industrielles et les simples pauvres dans les Écoles de Workhouses ou de Districts. Un anglais, non moins autorisé, qui prit part à ces discussions, M. Barwick-Baker, se montrait moins préocupé des catégories à établir que de la nécessité de séparer tout-à-fait, dans des Reformatories, les enfants vicieux de toute espèce:—"J'appelle l'attention," disait-il, "sur "notre systême de ne prendre que les plus mauvais. Si une épidémie "se déclare dans une ville et que j'offre d'emmener hors du pays 100 "personnes pour les soustraire à la maladie, je ne ferais que peu de "bien; mais si je puis trouver et conduire hors de la ville tous ceux

" qui sont atteints et les mettre dans l'impossibilité de communiquer
" avec qui que ce soit, que de vies ne sauverais-je pas ? "

En réalité pour défendre efficacement la société contre l'envahissement du crime, il faut éviter de s'enfermer dans un systême. Parmi les mineurs non susceptibles de l'éducation commune, il y a les incorrigibles, les vicieux, et, comme je le dirai plus loin, les *incurables* qui doivent être soigneusement séparés des autres, sous un régime exceptionnel; pour tous ceux qui sont susceptibles de réformation et d'amélioration la règle que l'éxperience impose c'est de les classer par catégories, moins d'après les actes qui les ont fait sortir de la vie commune que d'après leur âge et surtout d'après une appréciation attentive de la nature morale. Cette règle doit servir pour le partage à faire entre le personnel des écoles de réforme et celui des écoles industrielles, et pour le classement à opérer dans chacun de ces personnels. Cette vérité n'était pas méconnue avant l'Act d'amendement de 1880, et j'en citérai pour preuve la création par le *School Board* de Londres d'une école industrielle pour 50 enfants indisciplinés (*Industrial School for Truant Boys*), soumis au régime suivant :—Règlement inflexible, écartant les peines corporelles, excepté dans les cas d'alsolue nécessité, substituant aux jeux ordinaires les exercises militaires; imposant absolument le silence, la propreté, l'ordre, l'observation des heures, et donnant par le calme, la fermeté du traitement et la haute autorité morale du chef de l'institution l'impression de l'inutilité de toute résistance; une surveillance attentive de jour et de nuit complétait ce régime.

Il faut donc admettre que pour tous les enfants que leur corruption précoce, leur perversité native, ou des actes criminels doivent exclurer de l'éducation commune, les systêmes d'éducation correctionnelle où d'éducation préventive sont subordonnés à cette nécessité d'avoir des établissements de types variés d'après l'âge et la qualité morale, si je viens aussi parler, des enfants.

J'ai nommé, en passant, les vicieux, les incorrigibles, les incurables. J'y reviens en finissant, parceque le plus redoubtable fléau de nôtre temps, l'alcoolisme, par ses effets héréditaires et les dégénérescences qu'il entraîne, donne à cette classe de mineurs, dangereuse entre toutes, une importance numérique qui va croissant dans certains milieux. Lorsqu'on parle du péril social causé par la progression de la criminalité juvénile il n'est pas possible d'éviter cette question là. Le Règlement du Congrès m'interdit de la traiter. Je veux soumettre seulement, sans discuter, quelques propositions au Congrès.

On peut partager en deux catégories les sujets dont je parle et comme ils n'appartiennent pas par leur état moral, ni même souvent par leur constitution physique à la partie saine de l'humanité, il y a lieu de séparer ceux qui sont *curables* par une éducation appropriée de ceux qui sont *incurables*.

La première catégorie abonde, en tous pays, dans les maisons d'éducation correctionelle, où elle porte le trouble et trop souvent la démoralisation. Ce sont ces mauvais sujets, toujours prêts à malfaire et rebelles à toute bonne discipline, ces natures nativement réfractaires aux lois de l'ordre moral et social ne peuvent être pliées et constraintes

que par un régime exceptionnel dans lequel une force extérieure, d'une action irrésistible, contient les impulsions instinctives, prend la place de la volonté, entraîne la pensée elle-même, en réglant tous les actes de la vie. Assurément tous ces manvais sujets ne sont pas dignes de faire partie de l'armée ou de la marine; il n'est pas moins vrai que c'est dans l'emploi sévère des règles de la discipline militaire ou maritime qu'il faut chercher et qu'on a trouvé jusqu'ici les meilleurs résultats. L'histoire des *Training Ships*, comme celle des compagnies de discipline, ou même des sociétés, qui s'occupent de l'engagement des jeunes détenus dans l'armée prouvent qu'il faut marcher et avancer le plus possible dans cette direction.

L'alcoolisme a une part considérable dans la génése de ces mauvais sujets, et j'en citérai comme exemple les résultats d'une enquête récente du Conseil fédéral suisse qui établissent que dans les maisons de correction de jeunes détenus de ce pays, la moitié des garçons et la moitié des filles sont issus des parents alcooliques. C'est aussi à l'alcoolisme, à la dégénérescence, ceux dont il est la source qu'il faut attribuer surtout la multiplication redoutable de ces sujets qui appartiennent tout-à-fait à la pathologie humaine, que j'ai appelé les incurables, et que les medecins aliénistes, à l'examen des quels la justice les livre après leurs actes criminels ont appelés les *instinctifs*, les *dégéneres*. Ce qui caractérise ces sujets c'est la précocité des instincts criminels, l'absence de résistance à ces instincts et l'impossibilité de participer aux actes de la vie sociale sans s'y manifester par des actes criminels. Traduits devant la justice les mineurs de cette espèce sont ordinairement déclarés irresponsables, et c'est sur les conséquences de cette déclaration que je veux ajouter encore quelques mots qui s'appliquent bien moins à l'Angleterre qu'à d'autres pays.

En Angleterre lorsque l'auteur de certains actes qualifiés *crimes* comparaît aux assizes, si le jury déclare que le coupable est "*of unsound mind*" ce coupable est acquitté; mais la société n'est pas du même coup, condamnée, comme elle l'est ailleurs, à souffrir du renouvellement des mêmes actes criminels. Considéré comme malade, comme aliéné dangereux, l'individu acquitté est enfermé dans un asile spécial, d'où une déclaration de guérison par le médecin ne suffit pas pour le remettre en liberté. Il y est placé "*sous le bon plaisir de la Reine*," c'est-à-dire, que le pouvoir public a sa main mise sur lui indéfiniment et qu'à moins de garantie, dont ce pourvoi est le seul juge, il reste bannis pour toujours de la société.

Je ne veux pas rechercher s'il n'est pas fait abus, dans les procès criminels, de l'excuse d'irresponsabilité. Je ne veux pas m'élever contre une appréciation qui ne relève que de la science, mais en présence du détriment qui en résulte pour la société, je ne puis m'empêcher de réclamer, suivant l'exemple de l'Angleterre, des mesures protectrices, dont je voulais pour mon compte étendre le principe et l'application à tous les individus criminels ou dangereux, reconnus irresponsables, à quelqu'âge, à quelque sexe, à quelque catégorie sociale qu'ils appartiennent. J'admets la parfaite justice des sentences, qui, même après de grands crimes, exempte les mineurs de cette espèce du dernier supplice, ou

même de chatiement ; mais c'est un sentiment d'humanité bien aveugle et mal fondé que celui, qui, permettant leur retour, tôt ou tard, à une vie de relations pour laquelle ils ne sont pas faits, sacrifie à leur liberté l'intérêt social doublement lésé par de nouveaux attentats contre les autres citoyens, et par la propagation de tares héréditaires dont le propre est de s'aggraver toujours.

Je dois m'arrêter devant l'examen detaillé des mesures pratiques à appliquer. Il me suffisait d'ailleurs d'en voir admettre le principe. J'ai insisté sur la nécessité du classement et des séparations pour le succès de l'éducation correctionnelle et de l'éducation préventive de tous les sujets educables soumis à ces régimes particuliers. Je ne pouvais pas passer sous silence la catégorie des non-éducables et je n'ai pas cru devoir reculer devant la conclusion qu'une étude longue et consciencieuse m'a imposée. J'appelle sur elle le jugement de ceux qui pensent, avec moi, que ce qui il y a de mieux et de plus pressant à faire pour notre sociéte, après tant d'améliorations et de progrès matériels, c'est de travailler surtout au perfectionnement de l'homme moral.

DISCUSSION.

Miss Davenport Hill said:—The danger of relieving parents of their responsibility is that it creates the very evils we are attempting to remedy. Such amelioration is of slow growth. It is better effected by indirect means, such as compelling the attendance at school of children of careless and neglectful parents.

Some provisions in the Industrial Schools Bill of last year would be of great advantage. Many children sent to an industrial school need only healthy family life to turn them into well-behaved boys and girls. The rule which prevents managers of industrial schools from receiving weakly or deformed children who are supposed to be unfit for industrial training is objectionable. Many among them become healthy during their sojourn in the school, and nearly all can be taught some means of obtaining their own living. The provisions in the Act of this session enabling managers to emigrate or apprentice their pupils will do much to prevent the injury which vicious parents can inflict on young people who, having attained the age of 16, quit industrial schools, from the want of any legal provision which would enable managers to protect their former pupils.

Mr. George Margerison, referring to Mr. Mitchell's paper on "Neglected Children," pointed out that the law which Mr. Mitchell suggested should be passed to prevent boys and girls above 12 sleeping in same room as their parents, was already in operation in London, at least. Every sanitary authority was empowered by the Public Health Act to make byelaws for separation of sexes in all houses occupied by more than one family. He thought that Mr. Mitchell's suggestion that authorities might, where such law was put in force, pay the additional sum required when satisfied of the inability of the parents to do so, was a good one. He begged therefore to propose: That in any case where the sanitary authority puts the provisions of the Public Health Act into operation, the parent or guardian may, if unable from poverty to provide sufficient

lodging, apply to some properly constituted authority, and it shall be the duty of the said authority to pay the additional sum required when satisfied of the inability of the parent. This was not seconded.

Dr. T. W. Grimshaw (Registrar-General for Ireland) stated that the last speaker (Mr. G. Margerison) had dealt with the principal point to which he, Dr. Grimshaw, wished to refer, namely, that the existing statutes by which urban sanitary authorities had power to make byelaws for the separation of the sexes in tenement houses contained the provisions which Mr. Mitchell recommended as requiring new legislation. Dr. Grimshaw supported Miss Davenport Hill's strong protest against removing parental responsibility, though he would show no mercy to negligent or cruel parents, as was pretty well shown by the fact that he was Chairman of the Dublin Branch of the National Society for the Prevention of Cruelty to Children. He regretted that time did not permit of his referring to the questions connected with reformatory and industrial schools, the statistics of which he had to report upon annually.

Mr. Lloyd Baker said: As regards Mr. Mitchell's paper, I must state my belief that mechanical means have little to do with morality. The Northumberland labourers live in one room; and if they possess a second, keep it as a show or spare room. Yet immorality is very rare. No doubt they use ordinary precautions against indecency. I wish to call attention to the pamphlet addressed to mothers by Miss Ellice Hopkins, who states that a family may be brought up in one room with perfect decency by the careful use of a screen. Colonel Prendergast has spoken of the establishment of reformatories. I must do honour to the name of Captain Brenton, who originated the system. His school was attacked by groundless reports, and had to be closed. Some years after, when my father and others established the present reformatory system, it was on the lines laid down by Captain Brenton.

Colonel Prendergast has spoken of the industrial schools as a development of the reformatories; and of the further development of truant schools. I will add that we require a further development still, by the establishment of classified reformatories for older and younger boys, for weakly or very vicious boys.

Disposal is difficult; but we have always got places for our boys, and have found that over 90 per cent. go on well. What is called the "prison brand" has never caused the slightest difficulty. A shipowner has even returned to visit the school and talk of the benefits he received there, although his being there was a proof that he must have been in prison.

Assistance des Orphelins considérée au point de vue de leur Hygiène Physique et Morale.

PAR

le Docteur VICTOR DESGUIN, de l'Académie Royale de Médecine de Belgique, Conseiller communal de la Ville d'Anvers.

Depuis les temps les plus reculés, on s'est préoccupé du sort des enfants indigents que la mort de leurs parents ou leur abandon privait de leurs soutiens naturels. Ils étaient l'objet de la commisération

publique et l'on trouve, dans la plupart des législations anciennes, des marques non équivoques de la sympathie qu'ils inspiraient. Presque tous les peuples, en effet, ont édicté des lois mettant les orphelins à la charge de l'État, ou obligeant les particuliers à pourvoir à leurs besoins matériels.

Ce n'est pas ici le lieu de faire l'historique de ces diverses prescriptions légales. Peu à peu, la bienfaisance publique et officielle, s'organisant dans les pays civilisés, eut dans ses attributions le soin des orphelins, des enfants trouvés et abandonnés; tandis que la charité privée, réunissant ses efforts épars et se constituant en associations, créait des refuges pour les recevoir et remplacer pour eux la famille absente.

La mort ou l'abandon des parents constitue donc aujourd'hui un véritable droit à l'assistance, et les orphelins sont considérés comme étant les pupilles naturels des administrations charitables et des particuliers bienfaisants, qui, malgré l'égoïsme dont on se plaît à accuser notre siècle et notre société, ouvrent largement leur bourse pour soutenir les déshérités de la fortune.

Presque partout on a trouvé que le meilleur moyen de sauver les orphelins de la misère, de leur donner l'instruction et l'éducation, de leur faire apprendre des métiers qui pussent les rendre plus tard indépendants, était de créer des maisons de refuge, sous le nom d'orphelinats.

Les premiers orphelinats qui furent établis, et dont nous avons encore vu des spécimens il n'y a pas bien longtemps, laissèrent beaucoup à désirer sous le point de vue de l'hygiène et même sous le point de vue de l'éducation. Il faut avoir visité les véritables cabanons dans lesquels ces petits malheureux étaient enfermés, pour se convaincre que le but qu'on devait poursuivre était loin d'être atteint.

Ce but, quel est-il ?

Il ne s'agit ici que d'enfants appartenant à la classe indigente. Les uns ont perdu leurs parents, par suite de maladies ou d'accidents, les autres ont été abandonnés par eux, d'autres ont été trouvés sur la voie publique, d'autres enfin ont été moralement abandonnés, c'est-à-dire, appartiennent à des parents condamnés à la prison, ou indignes, ou incapables de leur donner les soins nécessaires. Tous se trouvent actuellement sans moyens de subsistance, sans soutien, et ne peuvent rien espérer dans l'avenir. L'assistance publique a pour devoir de mettre ces enfants à l'abri du besoin, de les loger, nourrir et vêtir, de les préserver de la contagion du vice, et puis d'en faire des personnes à la fois saines et morales, capables de gagner plus tard honorablement leur vie et d'occuper dans la société une place convenable.

La plus grande partie de ces enfants sont porteurs d'une tare originelle et, s'ils ne sont pas malades dès leur naissance, on peut dire qu'ils sont prédisposés à certaines maladies, qu'ils les ont, en quelque sorte, en puissance. En effet, la plupart des personnes qui succombent à la fleur de l'âge sont emportées par des maladies héréditaires. Nous savons que la tuberculose, dans presque tous les pays, enlève environ la cinquième partie de la population; nous connaissons les ravages

effrayants causés par l'alcoolisme, qui ne se borne pas à tuer ceux qui en sont atteints, mais frappe également leurs descendants et en fait, pour l'avenir, des ivrognes et des dipsomanes; puis viennent la syphilis, la scrofulose, les maladies mentales, etc. Toutes ces maladies héréditaires ont imprimé leur cachet sur les petits malheureux qu'elles ont privés de leurs parents. Il n'y a aucune exagération à dire que la plupart des orphelins et des enfants abandonnés sont issus de parents atteints de maladies héréditaires. Et, dans le cercle de ces maladies héréditaires, il faut comprendre les maladies morales, c'est-à-dire, le vice; les enfants de parents assassins, voleurs, faussaires, etc., n'ont pas seulement hérité des dispositions physiques de leurs auteurs, mais ils ont la plus forte propension à se livrer aux mêmes vices qu'eux, à commettre les mêmes délits. Dans le dénombrement des prostituées, on a observé que les filles illégitimes en fournissent une proportion beaucoup plus forte que les filles légitimes : la débauche elle-même est héréditaire.

Il ressort de là que la première préoccupation de l'assistance des orphelins doit être de leur donner la santé physique et morale. Ces enfants, qui sont, souvent, d'une constitution débile, détériorée, doivent être régénérés, et il faut que l'œuvre de la bienfaisance, soit officielle, soit privée, consiste à les mettre dans les meilleures conditions pour affronter les luttes de la vie et faire souche, plus tard, d'enfants bien portants. Combien ne voit-on pas d'ouvriers mourant dans la force de l'âge et laissant des familles dans la misère parce que, nés eux-mêmes de parents malades, ils n'ont pas été soumis dans leur enfance à des soins qui aient reconstitué leur organisme ! Fortifier la santé des orphelins, c'est donc travailler à l'amélioration de la classe ouvrière, diminuer pour l'avenir les charges de la bienfaisance et leur préparer à eux-mêmes une vie active et heureuse, au lieu des déboires et des malheurs que la maladie entraine toujours à sa suite. Un état bien constitué, qui, faisant même abstraction de toutes questions de sentiment, n'envisagerait que son intérêt matériel, mettrait sur la même ligne que les orphelins les enfants nés de parents atteints de maladies héréditaires; il créerait pour eux des colonies agricoles ou maritimes, ou telles œuvres ayant le même but. Quelque dépense qu'il dût en résulter, il se trouverait après peu de temps avoir réalisé des bénéfices considérables : il aurait épargné de nombreuses vies humaines, dont chacune a sa valeur, car chaque individu valide coopère à la prospérité générale; il aurait diminué de beaucoup le nombre des malades et de la sorte dégrevé le budget, partout si chargé, des hôpitaux et des hospices. En somme il aurait fait une bonne affaire financière, tout en accomplissant une œuvre d'intelligente philanthropie.

Nous sommes sans doute bien loin de la réalisation de pareilles idées; ce n'est pas, quand tous les gouvernements se ruinent par leurs formidables armements, quand tous les budgets sont en déficit, qu'on peut songer à créer des institutions qui, au début, coûteraient des sommes considérables. Espérons qu'un jour viendra où les nations, plus sages, consacreront aux œuvres pacifiques et humanitaires toute l'activité qu'elles déploient actuellement dans le perfectionnement de leurs moyens de destruction ou de défense et que, dans une noble et féconde émulation,

elles s'efforceront d'avoir les citoyens les plus sains, les plus valides, les plus moraux.

En attendant revenons à nos orphelins.

Si la santé est la condition indispensable de tout travail fructueux, elle est également, jusqu'à un certain point, et surtout dans la classe ouvrière, une garantie de moralité. Que la débauche engendre la maladie, c'est incontestable. Mais l'état maladif est souvent lui-même la cause de l'immoralité, d'abord parce qu'il peut être le résultat des vices des ascendants, qui sont héréditaires, ensuite parce qu'un organisme affaibli résiste mal aux tentations du vice et aux sollicitations de la misère. On voit donc que la question sanitaire est absolument dominante dans l'assistance à donner aux orphelins; il importe assez peu qu'ils aient bon gîte, bonne nourriture, bonne instruction, s'ils ne sont pas en même temps vigoureux et résistants. Il ne faut pas oublier qu'ils doivent plus tard se subvenir à eux-mêmes, non seulement par les connaissances qu'on leur aura données, mais aussi par les qualités physiques et morales qu'ils auront acquises.

Étant donné que ces enfants ne sont pas malades, mais seulement prédisposés à le devenir, puisque beaucoup d'entre eux sont issus de parents qui ont été emportés par la tuberculose, par les lésions consécutives à l'alcoolisme, par la syphilis, etc., que d'autres ont été engendrés dans le vice et la débauche, on combattra ces prédispositions par le moyen des puissants modificateurs hygiéniques que la science possède, et qui sont principalement: le grand air, le travail musculaire et le régime alimentaire. Il est à peine nécessaire d'insister sur l'importance de ces modificateurs. La vie en plein air, dans une région sèche et salubre, ou au bord de la mer, est certainement le moyen le plus efficace d'exciter tous les actes organiques, d'activer l'appétit, de favoriser les digestions, d'accélérer la circulation et de purifier le sang. Le travail corporel, les mouvements divers dans un air vivifiant régularisent les échanges nutritifs, augmentent la force musculaire et la résistance aux intempéries. Il va de soi que le régime alimentaire sera suffisamment abondant, suffisamment réconfortant pour permettre à l'organisme de réparer les pertes que le travail au grand air lui aura fait subir et le mettre en état de faire face à l'exercice musculaire qu'on réclame de lui.

Tels sont, en partant de nos prémisses, les principes qui doivent être appliquées dans l'assistance aux orphelins. Ces principes peuvent-ils toujours être mis en pratique? En d'autres termes: Quel est le système qui doit prévaloir dans l'assistance aux orphelins?

En étudiant les pratiques en rigueur chez les différentes nations, on constate que ces systèmes peuvent se réduire à trois: l'orphelinat —le patronat—le système mixte. Examinons rapidement chacun d'eux.

L'orphelinat fermé est le mode d'assistance le plus ancien, probablement le plus appliqué de nos jours et celui auquel semblent revenir certaines administrations publiques qui l'avaient abandonné. Il consiste dans l'internement des orphelins des deux sexes dans des établissements généralement spacieux, bien construits en point de vue de l'hygiène, souvent même trops luxueux et présentant trop de comfort. Les enfants y reçoivent une bonne instruction et y apprennent des métiers en rapport

avec leurs forces et leurs aptitudes. Ce système présente tous les avantages et les inconvénients des internats. Comme avantages : une surveillance de tous les instants, l'ordre, la propreté, la discipline ; comme inconvénients : l'absence de la vie de famille, le manque de spontanéité, de liberté, le défaut d'exercice suffisant, le danger des maladies, la trop grande facilité de vivre, qui fait envisager l'existence sous un faux jour, qui ne permet pas d'en voir les côtés pratiques ; parfois aussi la compression des caractères, la délation, la dissimulation. Les inconvénients de ce mode d'assistence sont-ils compensés par les avantages très réels qu'on y trouve ? Tous les hygiénistes sont d'accord en principe pour condamner l'internement des enfants. A la rigueur ils accepteraient les pensionnats placés à la campagne, ceux où les enfants jouissent de la plus grande somme de liberté possible et peuvent le mieux se livrer aux jeux, aux exercices nécessaires à leur âge, où ils respirent un air pur et constamment renouvelé, où leur mode de vivre ressemble le plus à celui de la famille. Les pensionnats urbains, qui ne réunissent pas ces conditions d'hygiène, sont absolument condamnés. Or, les raisons qui font rejeter les internats pour les enfants de la classe aisée doivent, à plus forte raison, les faire rejeter pour les indigents, parmi lesquels les orphelins, dont nous nous occupons, dont il faut souvent réformer les constitutions par l'exercice musculaire et par un air vivifiant et qui, sous peine de fortes déceptions, ne doivent pas être habitués à la vie facile, sans souci, sans caractère pratique, que l'on mène dans les pensionnats.

Les inconvénients signalés plus haut disparaissent dans le système du patronat. Ici, les orphelins, confiés à des patrons, soit à la ville, soit à la campagne, selon leur état de santé et le métier auquel on les destine, vivent absolument de la vie de famille, sont élevés avec les autres enfants, fréquentent les écoles de la localité, connaissent les difficultés qu'on éprouve à gagner sa vie, s'initient aux détails du ménage, apprennent de bonne heure la pratique de la vie. Souvent ils restent dans les ménages où ils ont été élevés et dont ils deviennent les enfants adoptifs, ils s'associent à leur patron dans l'exercice de son métier, ils contractent des alliances dans la localité. S'ils quittent leur patron pour s'établir, la transition n'est pas brusque, comme lorsqu'ils quittent l'orphelinat : ils ne s'étonnent plus des difficultés de l'existence, ils savent que rien ne vient sans peine ; dans l'atmosphère de liberté relative où ils ont vécu, ils ont acquis de la spontanéité ; en un mot, ils sont préparés aux luttes de la vie.

Les tout jeunes orphelins, ceux pour lesquels il ne peut encore être question d'apprentissage, peuvent de même être placés dans des familles, à la campagne, quitte à être repris plus tard, pour être confiés à des patrons exerçant un métier.

Pour que le système du patronat produise ses fruits, plusieurs conditions doivent être réalisées ; la première est le choix judicieux du patron ou du nourricier, qui doit être sain, sobre et honnête, autant que possible père de famille, pour que son nouveau pupille puisse être élevé avec les autres enfants, jouissant d'une aisance suffisante pour qu'on soit sûr que l'orphelin obtiendra la nourriture qui lui convient.

Une seconde condition indispensable est l'organisation d'un bon service d'inspection qui, fréquemment et à des époques indéterminées, exerce une active surveillance sur l'orphelin, s'assure de la manière dont on le traite et dont on l'instruit, s'enquière de son caractère, de ses défauts, de ses aptitudes, de son état de santé. Il faut, de plus, que les enfants malades reçoivent les soins nécessaires et, s'ils ne peuvent les avoir chez leurs patrons, qu'ils rentrent à leur lieu d'origine et soient placés dans les instituts destinés à leur traitement.

Enfin il est un troisième système, mixte, qui participe des deux précédents. Les enfants sont placés chez des nourriciers ou des patrons pendant quelques années, puis rentrent à l'orphelinat afin de se perfectionner dans leurs métiers. Ce système offre certainement de grands avantages sur celui de l'internement continu. La santé de l'orphelin a pu s'affermir pendant le séjour chez le nourricier ou le patron; il a vécu quelque temps de la vie de famille et n'est plus absolument ignorant des nécessités de l'existence et de ses difficultés. Rentré à l'orphelinat, l'enfant pourra devenir un ouvrier habile, qu'il n'aurait peut-être jamais été chez son premier patron. Ce mode d'assistance, toutefois, ne parait être applicable que dans un nombre très restreint de cas, lorsque les enfants ont une intelligence au dessus de la moyenne et présentent des aptitudes bien marquées pour un genre spécial de travail ou des dispositions sérieuses à des études plus élevées. Il offre l'inconvénient, pour les administrations et pour les associations charitables, de devoir maintenir des orphelinats en permanence, avec leur personnel, leurs frais d'entretien, etc. Encore y aurait-il moyen d'arriver au même but sans s'imposer ces dépenses : on pourrait placer ces jeunes gens, exceptionnellement doués, en pension dans des familles connues et ils iraient fréquenter les écoles ou les ateliers qu'on leur aurait assignés. C'est du reste la pratique usitée dans certains établissements fermés où les orphelins, pour compléter leur apprentisssage ou parfaire leur instruction, sont envoyés chez des patrons habiles et bien outillés, ou dans des écoles supérieures.

Le côté financier de la question qui nous occupe ne doit pas être perdu de vue; son examen nous fournira un élément de plus pour la résoudre. Les ressources de la charité officielle et privée sont nécessairement limitées et tous ceux qui ont droit à l'assistance ne peuvent en jouir. Il résulte de là qu'il faut adopter le système le moins coûteux, dès le moment qu'il offre toutes les garanties au point de vue du but à atteindre, de l'avenir des orphelins. Or, nous trouvons qu'en Belgique, et il y a lieu de croire que les pays étrangers n'offrent guère, sous ce rapport, de différences avec le nôtre, l'entretien d'un orphelin ou d'une orpheline dans les établissements fermés coûte en moyenne 400 francs par an, sans compter l'entretien du bâtiment et le capital immobilisé par sa construction, tandis que le placement chez des nourriciers ou des patrons ne coûte qu'en moyenne 110 francs, qui finissent même par ne plus devoir être payés, quand l'orphelin rend à sa nouvelle famille assez de services. La différence est considérable, et nous avons vu que ce système, le moins coûteux, est aussi celui qui répond le mieux au voeu de l'hygiène et qui assure le mieux l'avenir de l'orphelin.

La réponse à la question posée ne saurait donc être douteuse: il faut supprimer les orphelinats fermés et les remplacer par le système du patronat ou système familial.

Toutefois il faut reconnaître que certaines objections peuvent être opposées au système du patronat. Les enfants naturellement vicieux, ceux chez lequels on a découvert des défauts graves ou de mauvaises tendances ne peuvent pas profiter du séjour chez un patron ou même chez un nourricier. Pour eux, la liberté dont on y jouit serait préjudiciable. Ils doivent être l'objet d'une surveillance incessante, être soumis à une discipline éclairée et sévère. Le meilleur système à leur appliquer est celui de la colonie agricole, qui présenterait toutes les garanties au point de vue de la santé. Son établissement ne serait pas onéreux: il suffirait d'une ferme avec un terrain à cultiver. Sous une direction intelligente, les mauvaises dispositions des élèves se rectifieraient et l'on pourrait espérer que leur nature déviée se transformerait.

Une autre catégorie d'enfants ne sont guère destinés à profiter du placement chez des patrons: ce sont les scrofuleux, les rachitiques. Pour eux, la colonie agricole ne conviendrait pas absolument; il vaudrait mieux la remplacer par la colonie maritime. Des établissements de cette sorte ont déjà produit des résultats très encourageants. L'air vivifiant de la mer, avec ses propriétés particulières, constitue le modificateur le plus puissant à mettre en œuvre dans ces états maladifs. L'installation de ces colonies ne serait d'ailleurs pas beaucoup plus coûteuse que celle des colonies agricoles; rien ne s'opposerait d'ailleurs à ce qu'on y adjoignît une exploitation agricole.

Si les idées que je viens d'exposer étaient généralement admises, les associations charitables et les institutions de bienfaisance officielle réaliseraient, comme je l'ai montré, de sérieuses économies qui pourraient être utilement employées à secourir un plus grand nombre d'orphelins et d'enfants abandonnés, ou à créer d'autres œuvres également nécessaires.

Ce travail pourrait s'arrêter ici. Mais certaines administrations de grandes villes, qui ont essayé le système du patronat, probablement dans de mauvaises conditions, paraissent vouloir en revenir à l'orphelinat fermé ou au système mixte esquissé plus haut. D'autres, qui ont fait construire à grands frais des établissements magnifiques, se décideraient peut-être bien difficilement à les abandonner et à recourir à un autre mode d'assistance. Dans ces conditions, il est nécessaire d'examiner de quelle manière il serait possible de supprimer les inconvénients que nous avons reconnus aux orphelinats et d'autres encore dont je n'ai pas parlé.

Il est incontestable que, dans les orphelinats, la vie de famille n'existe pas. Les enfants sont donc privés de la meilleure école pratique qu'il y ait, de celle qui leur apprend au prix de quelles difficultés on se procure le logement, le vêtement, la nourriture et même le travail. Aussi, quand ils sortent de l'établissement à l'âge de 18 ou 19 ans, sont-ils parfaitement ignorants d'une foule de choses qui sont pour eux de la plus grande nécessité. Logés dans des locaux spacieux, bien aérés, bien chauffés, parfaitement aménagés, pourvus de toutes les commodités, avec éclairage au gaz et distribution d'eau, trouvant à heure fixe leur

couvert mis et leur nourriture préparée, ils se figurent aisément que, n'ayant dû se donner aucune peine pour acquérir ces biens, il n'en saurait être autrement plus tard. A leur sortie les attendent les déceptions; combien ne voit-on pas d'orphelins qui, entrés en service, sont tout étonnés de voir que, dans bien des maisons bourgeoises, il y a infinement moins de comfort que dans l'établissement qu'ils ont quitté! C'est surtout aux filles que s'applique cette observation. Les idées de grandeur et de bien-être que, malgré tout le tact de leurs maîtresses, elles ont emportées de l'orphelinat, faussent leur jugement; elles sont malheureuses dans les services où elles sont entrées, et changent bientôt pour entrer ailleurs et finissent parfois dans le dévergondage.

Notons que dans les orphelinats, il existe entre les enfants vicieux et ceux qui ne le sont pas, une promiscuité qui est toute au détriment de ces derniers. On sait que, dans l'enfance, l'exemple est contagieux, mais que le mauvais exemple est plus souvent suivi que le bon; ce sont donc les vicieux qui gâtent les autres, au lieu d'être amendés par eux. Dans le système du patronat pour les orphelins normaux et de la colonie agricole pour les vicieux, ce contact n'est pas à craindre. Dans les orphelinats, il ne saurait être complétement évité. Grâce à la discipline qui règne dans l'établissement, les défauts se cachent, mais ne disparaissent pas; ils ne sont pas corrigés. Et, comme il arrive des moments où la surveillance s'endort, où les enfants jouissent en commun d'une liberté relative, les mauvais corrompent les autres. Quand on visite un orphelinat bien tenu, on serait loin de se douter de cet état de choses: grâce à la politesse et aux bonnes manières inculquées aux enfants, on est tenté de croire que le moral répond toujours à ces excellentes apparences. Des faits graves sont venus parfois nous montrer que ce vernis d'éducation n'est qu'un trompe l'œil. Mais c'est surtout après la sortie des enfants, quand ils ont recouvré toute leur liberté, qu'on s'aperçoit des défauts qu'ils ont conservés, tout en les masquant sous la dissimulation que leur internement et la discipline à laquelle ils ont été soumis leur ont fait prendre.

Cette considération est certainement un des arguments les plus puissants en faveur de la suppression des orphelinats fermés.

Il faut, de la part de la direction, non seulement beaucoup d'énergie, mais beaucoup de talent et de tact pour arriver à amender les enfants vicieux et pour les empêcher de contaminer ceux qui sont normaux.

Nous avons vu quelles conditions générales doit remplir l'assistance des orphelins au point de vue de l'hygiène et de la santé. Il est bien difficile que les orphelinats placés au sein des villes ou des grandes agglomérations répondent à ces exigences. En n'envisageant que le côté sanitaire de la question, on admettra que les orphelinats devraient toujours être établis à la campagne. L'espace, en ville, est généralement trop restreint pour que les enfants jouissent des avantages de l'air libre; d'un autre côté, l'air des villes est, comme qualité, notablement inférieur à celui de la campagne.

Une objection que l'on peut faire au placement de ces établissements en dehors des agglomérations est la difficulté, surtout pour les garçons, de l'apprentissage des divers métiers. Mais cette objection,

très-fondée, tombe devant cette considération, que rien n'empêcherait d'enseigner la plupart des métiers à l'orphelinat même, jusqu'à ce que les jeunes gens fussent suffisamment avancés pour pouvoir être mis en pension et en apprentissage chez des maîtres, mieux outillés que l'établissement ; en appliquant par conséquent un système mixte, dont ne profiteraient que les jeunes gens ayant montré d'heureuses dispositions, permettant d'espérer qu'ils se perfectionnèront dans l'exercice de leur métier ; de même ceux qui montrent des aptitudes spéciales à l'étude seraient envoyés dans des écoles supérieures ; mais les uns et les autres formeraient l'exception, et l'orphelinat serait apte à donner à la généralité l'instruction primaire et une connaissance suffisante des métiers pour pouvoir devenir de bons ouvriers.

Pour les filles, le placement à la campagne n'offre aucun inconvénient, les métiers qu'elles sont appelées à exercer pouvant toujours s'enseigner à l'intérieur de l'établissement et ne nécessitant jamais de déplacements.

Que l'orphelinat soit construit à la ville ou à la campagne, il doit en tous cas être pourvu des installations nécessaires pour développer le corps, augmenter la résistance vitale, empêcher l'éclosion des maladies héréditaires, combattre le développement et la propagation de la tuberculose, des maladies zymotiques, de l'ophtalmie granuleuse. La gymnastique et la natation sont indispensables aux deux sexes, pour augmenter les forces, développer harmoniquement le corps, lui donner de la souplesse et de l'agilité, lui communiquer de la résistance. Au point de vue de la tuberculose, tout individu qui tousse doit être tenu pour suspect, surtout quand il est issu de parents morts jeunes et qu'il est lui-même de faible constitution. Connaissant la contagiosité de la tuberculose par les poussières de crachats desséchés, on évitera que les tousseurs ne crachent sur les planchers ou dans leurs mouchoirs.

Les enfants prédisposés aux maladies héréditaires et, en général, tous les enfants qui, sans être malades, sont malingres, chétifs, porteurs d'engorgements ganglionnaires, etc., doivent être soumis outre les exercices corporels, à une médication préventive destinée à fortifier leur constitution et consistant dans l'administration de moyens réconfortants et résolutifs, parmi lesquelles l'huile de foie de morue, les ferrugineux et les iodés tiennent le premier rang.

Pour éviter la propagation de l'ophtalmie granuleuse, qui, dans les internats, fait de nombreuses victimes et est éminemment contagieuse, on veillera à ce que chaque enfant ait son essuie-mains spécial et ne puisse se servir de celui des autres.

La teigne faveuse et, en général, les maladies contagieuses du cuir chevelu se propagent également avec grande rapidité. La meilleure mesure à prendre contre elles est de tenir les cheveux courts, d'interdire aux enfants de se servir du couvre-chef l'un de l'autre et d'isoler soigneusement ceux qui en sont atteints.

On connaît bien aujourd'hui le mode de propagation des maladies zymotiques ; il est inutile de les passer en revue. Qu'il nous suffise de faire à leur propos une recommandation. Les enfants qui en présentent les prodrômes doivent, autant que possible, être immédiate-

ment transférés dans les hôpitaux. Mais, comme l'hôpital peut-être assez éloigné et que la nature de la maladie n'est pas toujours reconnue dès l'abord, chaque orphelinat doit, outre l'infirmerie, qui est destinée aux blessures et aux simples indispositions, contenir une ou deux chambres d'isolement, afin de pouvoir y mettre les cas de maladies contagieuses qu'on ne pourrait envoyer à l'hôpital, ainsi que les cas douteux. Ces chambres d'isolement doivent être soigneusement désinfectées, chaque fois qu'elles ont été employées.

Naturellement, pour que toutes ces prescriptions, dont aucune n'est superflue, puissent être exécutées, l'orphelinat sera placé sous la surveillance incessante d'un médecin et, de plus, la direction devra posséder des notions d'hygiène assez étendues.

Un orphelinat, d'ailleurs, ne peut produire de bons résultats que si le personnel chargé de la direction, de la surveillance, de l'enseignement, est judicieusement choisi : les nombreuses qualités qu'on doit exiger de ce personnel rendent ce choix difficile. Les personnes qui le composent doivent être saines, vigoureuses et morales. Il faut qu'elles possèdent une autorité suffisante pour exercer sur les enfants une influence psychique prépondérante ; de plus leur perspicacité, leur talent d'observation doivent être assez grands pour qu'elles soient capables d'étudier le caractère et les dispositions des enfants qui leur sont confiés, de manière à combattre les tendances héréditaires au vice et à reconnaître les aptitudes de chacun.

Le personnel doit toujours être pénétré de cette idée, qu'il n'a pas affaire à un internat ordinaire, dont les élèves, après leurs études finies, rentreront dans leurs familles, où ils trouveront les conseils et l'assistance nécessaires pour se faire une position ; mais que, dès leur sortie de l'établissement, ils seront réduits à leurs propres forces et ne pourront compter sur aucune aide pour faire leur chemin dans le monde. De là l'obligation de rester toujours, avec eux, sur le terrain pratique, afin de leur éviter, dans l'avenir, des désillusions. L'administration, de son côté, ne perdra jamais ce but de vue. Aussi le régime alimentaire, l'habitation, le vêtement, tout en répondant parfaitement aux prescriptions de l'hygiène, seront-ils simples et excluront-ils tout luxe, tout raffinement. Les orphelinats anciens étaient fort défectueux au point de vue hygiénique ; bien des orphelinats modernes, que nous connaissons, pêchent par un excès contraire : ce sont de véritables palais où se rencontrent toutes les commodités de la vie. Aussi, quand des jeunes filles, élevées dans ces somptueux établissements, où elles trouvent de l'eau et des déversoirs à tous les étages, des machines à laver, etc., deviennent servantes dans des maisons de petits bourgeois, sont-elles dépaysées ; elles ne comprennent pas qu'il faille aller pomper l'eau, porter des seaux, faire la lessive à la main et bien d'autres travaux auxquels on ne les a pas habituées. Il serait très utile de leur faire mener, le plus souvent possible, la vie de famille. On les enverrait de temps en temps, par groupes d'une demi-douzaine, sous la conduite d'une maîtresse, passer quelques semaines à la campagne, dans une petite maison, où elles feraient elles-mêmes tout l'ouvrage ; cette

éducation pratique servirait plus à leur hygiène morale que tous les discours et tous les conseils dépourvus de sanction.

Si de la vie matérielle nous passons à la vie intellectuelle, les mêmes écueils sont à éviter. Sans doute il faut donner l'instruction aux orphelins des deux sexes, et même une instruction solide, développant le jugement et donnant des idées justes. D'une manière générale, l'enseignement doit être professionnel. Aller plus loin, c'est risquer de donner à ces enfants déshérités des idées ambitieuses, qu'ils ne pourront réaliser plus tard : c'est en faire des déclassés, rougissant de leur position, ne sachant pas la remplir et incapables d'acquérir celle à laquelle ils aspirent. L'instruction toutefois, tout en étant pratique, ne sera pas trop aride. On enseignera le dessin, qui peut toujours être utile dans une foule de professions, et même indispensable ; on enseignera également la musique vocale, qui élève l'intelligence et procure une agréable distraction.

Exceptionnellement, les enfants jouissant d'une bonne santé et montrant des dispositions spéciales, pourront être préparés aux études supérieures.

Quant au choix des métiers, il dépendra nécessairement des aptitudes des enfants, des dispositions qu'on leur a reconnues, de leur adresse, etc. Mais, de plus, il faudra tenir grand compte de leur état physique. Ainsi, il serait illogique et dangereux de faire apprendre le métier de couturière ou de lingère à des jeunes filles faibles de constitution, anémiques, issues de parents tuberculeux, ou prédisposées à la mélancolie et dont l'un des ascendants aurait été atteint d'aliénation mentale. Pour les garçons, il serait tout aussi mauvais d'enseigner un métier à poussières irritantes, comme celui de tailleur de pierres ou de boulanger, à ceux qui sont prédisposés aux maladies des voies respiratoires. Les qualités physiques de l'enfant doivent donc, plus même que leurs aptitudes, déterminer le genre de profession auquel on les destine.

En thèse générale, il faut éviter les métiers qui chôment une partie de l'année. La continuité du travail est une règle de discipline et de moralité. Si des métiers à chômage peuvent être impunément exercés par les jeunes gens vivant dans leurs familles, il n'en est pas de même pour les orphelins, qui, dès leur sortie de l'établissement, doivent pouvoir immédiatement gagner leur vie.

La façon dont les métiers sont enseignés mérite également considération. S'il est utile d'initier les jeunes gens aux procédés les plus perfectionnés, à l'outillage le meilleur, il ne faut pas oublier que les ateliers dans lesquels ils entreront ne rempliront pas toujours ces conditions et, pour leur éviter des déceptions, pour empêcher même qu'ils ne soient considérés comme incapables, on fera bien, pendant leur apprentissage, de leur appendre à exercer leurs métiers, même dans des conditions défectueuses, comme ils les rencontreront peut-être plus tard dans la vie.

Dans bien des pays, on fait une distinction entre les soins à donner aux orphelins et ceux que réclament les enfants trouvés et abandonnés. C'est un tort, à mon avis. Les uns et les autres, non seulement ont droit

à la sollicitude, mais doivent être soumis au même traitement, puisque les uns et les autres se trouvent dans une position identique, vis-à-vis de la société. En parlant toujours des orphelins, il est bien entendu que j'applique les mêmes principes aux enfants trouvés et abandonnés.

Je n'ai pas voulu traiter ici toutes les questions qui se rattachent à l'éducation des orphelins; beaucoup d'entre elles sont d'ordre administratif. C'est le côté hygiénique seul du problème, qui m'a préoccupé.

Les observations qui précèdent peuvent se résumer ainsi: Vie de famille pour les orphelins normaux;—colonies agricoles pour ceux qui sont vicieux;—colonies maritimes pour ceux dont la constitution est délabrée; en conséquence: suppression des orphelinats;—et, quand les orphelinats sont maintenus, prescriptions spéciales pour la santé physique et l'hygiène morale des pupilles.

Ueber die Nothwendigkeit der Reconvalescentenhäuser für Kinder.

VON

MARIANNE NIGG,

Volksschullehrerin in Korneuburg nächst Wien in Nieder-Oesterreich.

Unser Jahrhundert ist so reich an Schöpfungen, welche die Verbesserung der sanitären Verhältnisse unseres Erdballes regeln sollen, dass es eigentlich das Jahrhundert der Hygiene genannt zu werden verdient. Auch bei uns in Oesterreich wetteifern Humanitätsanstalten der verschiedensten Art, den Jammer und das Elend der leidenden Erdenbürger weniger fühlbar zu machen, ja, völlig zu bannen. Die grossartigsten, gediegensten Krankenanstalten für Erwachsene und Kinder geben Zeugnis hievon.

Weit entfernt, auch nur im geringsten daran zu denken, mich mit den gelehrten Vorträgen der Congressmitglieder messen zu wollen, wählte ich mein Thema als Bildnerin der Jugend und bitte, es auch in diesem Sinne aufzunehmen.

Wie manches Kind wurde durch die aufopfernde Sorgfalt des Spitalarztes am Leben erhalten und kehrt, dem Todesengel wie durch ein Wunder entrissen, geheilt in seine Familie zurück.

Armes Kind! Jetzt erst bedürfte es einer verdoppelten Pflege; jedes Lüftchen sollte abgehalten werden, der noch geschwächte Magen sollte durch zweckentsprechende Nahrung gestärkt werden und sollte erst wieder lernen die heimische derbe Kost zu vertragen, die zärtlichste Sorgfalt sollte jeden Schritt überwachen und nicht das kaum genesene Kind in das tolle Getriebe einer von Gesundheit strotzenden Kinderschar mit einbezogen werden, welche an den noch geschwächten Körper oft Zumuthungen stellt, denen er noch nicht gewachsen ist. Mit einem Worte, was Gold für ein gesundes Kind ist, das ist oft Gift für ein eben

genesendes Kind, für ein Kind, dessen Organismus arg zerrüttet war, das sich erst kräftigen sollte.

Fragen wir die Herren Aerzte und sie werden hunderte von Fällen aufzählen können, in welchen sie erkrankte Kinder mit Anwendung ihrer ganzen Kunst gerettet haben, die aber in der Zeit ihrer Reconvalescenz, da es ihnen an richtiger Nahrung mangelte, da sie einer guten Luft entbehren müssten, dem Siechthume verfielen und so für die Menschheit, für den Staat verloren waren. Wurden sie nicht sofort eine Beute des Todes, so hatten sie oft noch ein ärgeres Los, sie wurden, wenn sie am Leben blieben, Krüppel, unbrauchbare Menschen, eine Last der Gemeinde, des Staates. Dem, geehrte Versammelte, wäre abzuhelfen: Man errichte eigene Reconvalescentenhäuser nicht nur für die aus den Spitälern entlassenen Kinder, sondern überhaupt für solche Kinder, deren Verhältnisse es nicht gestatten, dass ihnen die liebevolle Pflege und Aufmerksamkeit während der Zeit ihrer Reconvalescenz von der Familie zutheil wird, damit sie, erst erstarkt, dem Alltagsleben im Kreise der Armuth übergeben werden und so die Zumuthungen, welche diese an die Jugend stellt, leichter ertragen können.

An guten Rathschlägen von uns aus fehlt es nicht, doch der Armuth ist wohl schwer rathen und so verfällt das arme Kind oft nicht nur körperlich, sondern oft auch geistig, und ich könnte hunderte von Fällen bezeichnen, wo geistig geweckte Kinder nach Scharlach-, Masern-, Blatternepidemien und anderen verheerenden Krankheiten, nach ihrer Genesung zu schwach waren, die gebotene geistige Kost aus Mangel an gehöriger Kraft zu verdauen und so geistig mehr oder minder verkamen.

Können Sie mir es verargen, dass ich als Bildnerin der Jugend Ihnen ganz begeistert die Schilderung dieser Wohlthätigkeitsanstalt mache, welche die Hochherzigkeit des Ehepaares August und Amalie Herzmansky aus Wien zu Stande gebracht, um so recht würdig den 25jährigen Bestand ihres Geschäftes zu feiern, welches hier in England durch seinen Export eben so gut bekannt ist, als bei uns zu Lande. Es wurde hier eine bleibende Stätte für ewige Zeiten geschaffen, um den früher bezeichneten Uebeln und Gefahren einen mächtigen Damm zu setzen: es ist das I. Muster-Reconvalescentenhaus für die aus den Spitälern Wiens geheilt entlassenen Kinder in Weidlingau im Wurzbachthale in Nieder-Oesterreich. In Weidlingau, eine reizende Sommerfrische, wurde es auf einem der schönsten Punkte errichtet. Das Hauptgebäude, ein imposanter Bau im italienischen Stile, umflossen von Sonnenlicht und milder ozonreicher Luft, steht einladend auf einer Anhöhe und dient den armen aus den Spitälern Wiens geheilt entlassenen Kindern zum Aufenthalte von Mai bis October jeden Jahres. Durch vorsorgende, aufopfernde Betreuung wird die schwache Lebensflamme der armen Kinder neu angefacht und erhalten.

Wunderschöne Bäume und Pflanzengruppen, desgleichen auch ein Springbrunnen, erfreuen den Besucher und überall bemerkt man auf weissen Täfelchen die Namen der Bäume und Gesträucher angebracht. Eine zweiarmige Treppe führt uns auf eine im Parterre liegende

Veranda, die breit genug ist, um den Kindern an Tagen, wenn die Gartenwege feucht sind, Aufenthalt zu gewähren. Von hier kommen wir durch eine Flügelthüre in einen hohen, luftigen mit den Bildnissen der Stifter geschmückten Saal, der zu beiden Seiten Tische und Stühle hat. Grosse Wandschränke, viele interessante Anschauungsgegenstände enthaltend, befinden sich an den Wänden und selbst diese haben Stellagen mit interessanten Anschauungsgegenständen, meist aus fremden Ländern und Erdtheilen. Diese werden an Regentagen vorgezeigt, und so lernen die Kinder in bunter Reihenfolge tausenderlei interessante Objecte kennen, die nicht des Unterrichtes wegen vorgezeigt werden, sondern nur da sind, damit der Geist angenehm angeregt werde und nicht erschlaffe.

Auch die Freude, etwas zu schaffen, ist den Reconvalescenten gegönnt. Die für alles bedachte Gründerin sorgte für Regentage vor, indem sie aus Stoffabfällen und Mustern ihres Manufacturgeschäftes die reizendsten praktischen Gegenstände, als Täschchen, Untertassen, Rahmen, Röckchen u. a. Dinge anfertigen lässt, welche dann Eigenthum der Kinder werden. Aus diesem Saale kommt man in einen breiten, mit Teppichen belegten Corridor, und durch die gegenüberliegende Thür treten wir in einen luftigen Speisesaal. Zwei Reihen nach der Grösse der Kinder zu regulierende Tische und Bänke fallen uns hier ins Auge. Bemerkenswert sind die zum Hineinstellen der Teller gemachten Oeffnungen in den Tischen, damit genau die Distanz beim Sitzen eingehalten wird, und die Teller nicht hinabgeworfen werden können. Jedes Kind hat hier eine Lade, in welcher das Besteck, der Trinkbecher und der Teller nummeriert sind und genau mit seiner Aufnahmsnummer übereinstimmen.

Im Parterre befindet sich noch das Ordinationszimmer des Arztes, in dem auch die Aufnahme geschieht. In dem daselbst befindlichen Aufnahmsprotokoll werden alle Kinder und auch die Krankheit, von welcher sie genesen sind, verzeichnet.

Anatomische Gegenstände, Instrumente und Waschbecken befinden sich hier. Anstossend ist ein Sprechzimmer mit einer Bibliothek und einem Claviere; dies zur Zerstreuung der Kinder. Das Puppenzimmer ist im Bodenraume des Mittelbaues eingerichtet, der in einen Spielsaal umgewandelt ist; doch befinden sich die Kinder hier nur an Regentagen, da sie ja die ganze Zeit über im Freien gehalten werden.

Die 15 Meter langen Schlafsäle sind sehr gut ventiliert und haben so wie auch die übrigen Räume Heizvorrichtungen, welche oft im Frühjahre und Herbste schon sehr nothwendig waren.

In weitem Abstande stehen hier in jedem der Schlafsäle Bettchen aus massivem Eisen, welche durch eine telegraphische Leitung mit den Zimmern der Wärterinnen in Verbindung stehen, so dass das Kind nur an einem am Kopfende des Bettchens befindlichen Taster drücken darf, um dieselben herbeizurufen, ohne die übrigen Kinder im Schlafe zu stören. Am Kopfende des Bettchens ist noch eine sinnreiche Vorrichtung angebracht, es befindet sich daselbst eine Nische zum Aufnehmen eines Glases Wassers oder der verordneten Arzenei. Ueber die Nische ist ein Vorhang mit einem Sprüchlein gezogen.

Jedes Bettchen besteht aus einer Drahtmatratze, und darüber eine Matratze aus Rosshaar mit darüber geknöpfeltem Leintuch, dass sie im Bedarfsfalle schnell umgewendet werden kann.

Damit die Kinder sich während des Schlafes nicht abdecken können, ist die überzogene Steppdecke mit Elastik befestigt. Ausserdem hat jedes Kind noch eine gehäkelte Decke.

An die Ankleidezimmer schliesst sich das Badezimmer. Dort befinden sich Waschtische mit den nöthigen Utensilien und in der Mitte ein Vollbad aus Zink mit warmer und kalter Leitung, welches 10 Kinder fassen kann. Ausserdem befinden sich hier noch Wannen zu Einzelnbädern mit mineralischen Zusätzen. Die einzelnen Stockwerke haben noch geräumige hübsch ausgestattete Zimmer für die Pflegerinnen, ein Isolierzimmer, wenn ein Kind plötzlich erkrankt, und die Wäscheverwahrung. Grosse hohe Kästen bergen reichliche Vorräthe von Bettwäsche, Leibwäsche und Hauswäsche, welche in grösster Ordnung hier aufgestapelt liegen.

Der luftige Garten wird häufig zu Rundgängen benützt und führt aufwärts zu einem herrlich angelegten Spielplatze. Rachitische Kinder, und solche, denen es frommt, haben hier einen grossen Sandhaufen, auf welchem sie, wenn er von der Sonne durchwärmt ist, verschiedene anregende Spiele spielen.

Um 7 Uhr morgens stehen die Kinder auf, um $^1/_2$8 Uhr abends gehen sie zu Bette und der grösste Theil des Tages ausser den Essstunden wird im Freien zugebracht. So wie die innere Einrichtung, wurde auch die ganze Verpflegung von der Gründerin in Erwägung gezogen.

Eine einfache, naturgemässe, schmackhafte, sättigende Kost, welche animalische und vegetabilische Nährstoffe in ausreichender Menge enthält, wird den Kindern geboten. Es wird darauf Rücksicht genommen, dass den Kindern die Nährstoffe in den richtigen Mengenverhältnissen durch die Speisen zugeführt werden, die Speisen Abwechslung bieten und schmackhaft und gar zubereitet sind und dem Sättigungsbedürfnis der Kinder völlig entsprechen. Auch ist Regel, dass denselben alle 2 Stunden Nahrung und Trunk gereicht wird.

Zum Frühstücke erhalten die Reconvalescenten Milch oder Eichelkaffee, zum Gabelfrühstücke mit Schinken oder Braten belegtes Brod, zum Mittagsessen Rindsuppe, Fleisch und Gemüse, zur Jause Butterbrod mit Rettig, oder Obst, zum Nachtmal Milchspeise oder Gemüse mit Beilage von Fleisch. An Sonn- und Feiertagen bekommen sie mittags Suppe, Braten mit Salat oder Compott und Mehlspeise. Ausserdem erhalten jene Kinder, denen der Arzt es verordnet, Rothwein zum Getränke.

Gepflegt werden die Kinder von 4 barmherzigen Schwestern, zu deren Beihilfe noch mehrere weltliche Personen bestimmt sind. Ausserdem wird das Befinden der Kinder vom Anstaltsarzte und vom Ortsarzte überwacht.

Die im Reconvalescentenhause aufgenommenen Kinder litten an allgemeinen Ernährungsstörungen; als: Blutarmut, Bleichsucht, Rhachitis, Scrophulose u. a. m. Ferner an Erkrankungen des Nerven-

systemes, als: Epilepsie, Veitstanz, Hysterie, Lähmung nach Diphteritis, Starrkrampf u. a. m.; an Erkrankungen der Respirationsorgane, als: Bronchialkatarrh, Lungen- und Rippenfellentzündung, Lungentuberculose u. a. m.; Erkrankungen der Verdauungsorgane, als: Magen-, Dünn- und Dickdarmkatarrh, Blinddarm- und Bauchfellentzündung, Magenblutung u. a. m.; an Krankheiten der Haut, an Erkrankungen der Gelenke, der Knochen, der Augen, an Verletzungen, Neubildungen und Infectionskrankheiten, doch werden mit letzteren Krankheiten Behaftete erst dann aufgenommen, wenn dieselben mindestens 8 Tage, nach der Entlassung aus dem Spitale gerechnet, in häuslicher Pflege zugebracht hatten. Die Kinder waren im Alter von 4 bis 14 Jahren, und die Summe der sämmtlichen Verpflegstage in den Jahren 1888 und 1889 beläuft sich auf 6,790 und auch 1890 war es so.

Die Leitung des ökonomischen Theiles führen Herr August und Frau Amalie Herzmansky, welche auch sämmtliche Kosten bestreiten.

Was wird z. B. aus Kindern oft, welche nach überstandenen Masern, Blattern, Scharlach und anderen Krankheiten, ihre Reconvalescenz in einer dumpfen Stube ohne die geringste Sorgfalt und Pflege durchmachten?

Im Schulleben haben wir oft die traurigsten Beweise davon. Geistig geweckte Kinder, die ähnlichen Krankheiten anheimfielen, sahen wir sichtlich herabkommen wieder.

Tagtäglich hören wir bittere Klagen nicht nur über unbrauchbare, kränkelnde, sondern auch über sittlich verkommene Menschen, und der Mangel einer brauchbaren Generation macht sich überall fühlbar. Selbst wenn wir Laien nachforschen würden, finden wir, dass die Verkommenheit der meisten Menschen die Folge einer krankhaften, nicht normal verlebten Jugend ist.

Der Staat aber braucht eine gesunde Generation, diese aber wird so lange nicht bestehen, als man nicht ein besonderes Augenmerk, nicht nur den vollkommenen und unvollkommenen Kindern, sondern auch denen zuweiset, welche einer Kinderkrankheit unterworfen waren. Man errichte daher Reconvalescentenhäuser für genesende Kinder, deren Eltern nicht im Stande sind, auch noch während dieses so wichtigen Ueberganges von der Krankheit zur völligen Gesundheit denselben eine besondere Pflege angedeihen zu lassen.

Der Menschheit würde alljährlich eine nicht zu unterschätzende Anzahl vielleicht künftiger Zierden erhalten werden und auch gesunde geistige und dadurch sittliche Zustände jedenfalls in vielen Fällen erreicht werden.

Meine Bitte geht nun dahin, der VII. internationale Congress für Hygiene und Demographie nehme den von mir erstatteten Vortrag nebst dem Berichte über das vom Ehepaar August und Amalie Herzmansky gegründete I. Reconvalescentenhaus zu Weidlingau im Wurzbachthale in Nieder-Oesterreich nächst Wien zur geneigten Kenntnis und befürworte folgende von mir gestellte Resolution: Der VII. internationale Congress für Hygiene und Demographie spricht die dringende Nothwendigkeit aus, dass, um den immer mehr zu Tage tretenden Klagen von unbrauchbaren, kränkelnden und siechen Menschen wirksam Abhilfe zu schaffen,

ausserhalb grosser Städte Reconvalescentenhäuser für Kinder von Gemeinden, vom Lande oder vom Staate zu errichten seien, in welchen nicht nur den aus den Spitälern entlassenen, sondern überhaupt allen jenen Kindern Pflege in ihrer Reconvalescenz zutheil werde, deren Familien nicht in der Lage sind, dazu die nöthigen Erfordernisse aufzubringen.

Denn wahrlich meiner innersten Ueberzeugung nach, werden die Summen, welche Gemeinde, Land und Staat hiefür anwenden, sich reichlich verzinsen und in dem Masse als man darangeht, Reconvalescentenhäuser für die Jugend zu errichten, werden die bedeutend grösseren Auslagen für Spitäler Irren- und Siechenhäuser schwinden und eine bessere, tüchtigere Generation der am höchsten dafür anzuschlagende Gewinn sein!*

Free Dinners for School Children.

BY

The Rev. J. Llwelyn Davies, M.A.

Every one is more or less touched by anything painful in the condition of a young child. There is nothing, perhaps, that stirs the common human indignation more quickly than the sight of cruelty practised upon a child. We cannot bear to think of young children insufficiently fed, or insufficiently clothed, or very badly brought up. But that a considerable number of children are exposed to the chronic pressure of these disadvantages is a fact which we are sometimes compelled to recognise. And the obvious cause of so deplorable a state of things is that those children do not receive from their parents the treatment that we should all wish them to have. The parents are either to be pitied or to be blamed; they are either too poor to give their children what they need, or they are too reckless—spending in drink or other forms of indulgence what ought to go to the support of the family—or they are vicious and give their children a shockingly premature training in vicious habits.

The most thorough-going remedy for this mournful evil, the most unrestrained response to the cry of the suffering children, is a proposal which some benevolent persons do not shrink from advocating, that the State should accept into its charge, from the moment of birth, every child that parents are willing to surrender, and take by force from the

* A model cot and appurtenances used to illustrate this paper were presented by the Author, on behalf of Frau Amalie Hertzmansky, to the North-Eastern Hospital for Children.

parents every child to which they are not doing the minimum of justice. If the magnitude of this remedy takes our breath away, it must be admitted that it has great attractions, and that strong arguments might be adduced in its favour. But the proposal is not yet urged upon the public by any person of weight, or by any large number of persons; and those who are in favour of the scheme would probably expect it to be reached by degrees.

A long way short of this, there is a proposal which appears on advanced programmes of social reform, that a free dinner should be given at the public expense to every child at school who will accept it. It may reasonably be asked, why this gift should be granted rather than other gifts which the interest of society seems equally to ask for. Economically, the provision of a free dinner is a grant of, say 6*d.* a head per week, to all parents of school children who like to take it. But why should such assistance be restricted to a mid-day meal, and to children at school?

It is very important that infant children should be well fed from their birth, and abundant food supplied to mothers for a certain period would be pronounced to be essential for the rearing of healthy children.

Then more injury is often caused by inadequate clothing than by want of food; why should not children be kept well supplied with warm clothing and sound boots? It is argued that a dinner may be regarded as indispensable to education; and that, as the State supplies education, and compels children of a certain age to take it, it is reasonable that food, without which they cannot learn properly, should be supplied with the teaching. At any rate this is the most obvious and easy beginning of grants-in-aid to parents of families.

I should not be disposed to apply the epithet "pauperising" to a public provision of dinners for school children. The worst evil denoted by that term is that of tempting people to be mendicants, and to submit to the ignominy of a searching and suspicious inquiry into their private affairs; and the next is that of tempting them to rely on chances of relief. Anything which is supplied for all persons to take or leave their choice, and which can be relied upon as a certainty, may be compared to a natural advantage, like a stream brought past one's door. But it is a grave question to what extent it is to the public good that parents should be relieved by the State of the burden of maintaining their children. It is from this general point of view that the proposal to offer at least one meal a day to every child attending school should be considered.

But, in the meantime, there is a plan at work already for accomplishing a part of what is aimed at by that scheme. Philanthropy is giving occasional dinners on a considerable scale to selected children, is glorying in its work, and is asking aid to extend this work. Is this a judicious form of relief, and one which ought to be extended? I am afraid there are irresistible reasons for answering 'no' to this question.

The children that receive the charitable dinners are selected. That is an essential feature to the plan. How are they selected?

When the kind-hearted lady, to whom the organisation of dinners for board school children in London is chiefly due, began to consult teachers, the mistress of a large school immediately asked, whether the children of drinking parents were to be recommended for tickets. "Certainly," said the lady, "they are the most to be pitied." And so they undoubtedly are. The most ill-fed and ill-clad children in our schools, for the poorest are sure to be the children of the worst parents. But by the time the scheme was ready to put before the public, it had been seen that there are grave objections to a plan for feeding the children of bad parents, and it was decided that only the children of "respectable" parents should have the dinner tickets given them. A scheme founded on the fact that there are many school children needing good food, began by disfranchising the great majority of them. With a view to the proper selection, the characters of the parents have to be ascertained. The teachers have some means of knowing about the parents, but their knowledge is not complete, and the parents are visited by members of the dinners organisation. This sort of investigation by a visitor is always a painful process, and very apt to be inadequately performed. More or less thoroughly, the parents who are at the same time respectable, and are not able to give the necessary food to their children are sifted out, at the peril of reducing the number too much.

The distribution of tickets to hungry children is made in the schools, and those who evidently want the food most, if they are not bluntly told, are inevitably made to understand that they are refused because their parents are unworthy.

This seems to me, I confess, a most unfortunate feature of the scheme. I cannot imagine that teachers and visitors can bring themselves to be rigid in their exclusions. But the theory is that the help is given only to parents whom, upon the commonly received principles, it is judicious to relieve. The system is thus brought under the head of charitable relief in general. Our sympathy is invited for widows with children to maintain, for families stricken by illness or misfortune. And we are thus led to ask, whether the dinner giving is a good piece of machinery for helping such persons. On the contrary, it is a cumbrous one, working ineffectively, and giving much needless pain. The best way of relieving the poor is through those who have the best and most natural knowledge of them, and the mode of giving should be as respectful and trustful as possible, and the amount large enough to be of some real use. How is a widow, struggling to maintain a couple of children, to be most satisfactorily helped? I do not say that she will not be glad that her children should now and then have a better dinner than she can afford given them; but it will be more acceptable that she should have a weekly allowance that she can depend upon, and that she, the mother, should apply the money according to her own judgment for the benefit of her children.

Any action which takes the children off the parents' hands and makes them the immediate objects of relief is to be deprecated. It is a matter of supreme importance for our social well-being that the

family relations should be maintained in health and strength, that parents should be encouraged and pressed to care properly for their children, and children in their turn to care properly for their parents. This object is so paramount, that neither the State nor philanthropy ought to be easily persuaded, in the pursuit of other desirable ends, to work against it. In the class of the very poor, there are special difficulties in fulfilling family duties. Sound policy would say, not "Let there be no demand of the fulfilment of family duties amongst the poor"; but "Let us be especially careful to avoid acts which may tempt the poor to disown them." Thus it is evident that the maintenance of disabled parents is a burden on working people, and good nature would suggest that instead of calling upon sons to maintain their parents, the State should undertake to do it. It was one of the abuses of our Poor Law system in former day, that it gave out-relief easily to old people, and excused the sons. I confidently call this an abuse, because every one who is competent to judge is aware that it did harm, and that great and manifest good has been done upon the whole by a greater strictness in refusing relief to those who have sons able, though with difficulty, to maintain them. Similarly, to assume that young children are to be taken off their parents' hands by the State or philanthropy, is a principle likely to do great harm. It will tempt parents to be neglectful of their children, and the class of young children will themselves on the whole be injured by it. If it were carried out, indeed, to the extreme length, so that the State should take charge, in a kindly spirit, of all children who are in danger of not being happily brought up by their parents, we might be almost fascinated by such a policy; but until we adopt that, all experience concurs with sound theory in urging that parents should be held, to the utmost possible degree, responsible for their children.

What, then, is to be done when parents spend their money in drink, and leave their children only half fed? This is a most painful question, and no answer that can be given to it will satisfy us. You will not mend things by giving food occasionally to the children, because that will be direct encouragement to the recklessness of the parents. Something may be done in extreme cases in the way of deterring the parents by punishment. But we may find most comfort, perhaps, in knowing that the number of such unnatural parents is not large, and is steadily diminishing. Where, however, parents are anxious to do their duty towards the children, but are prevented by extreme poverty from getting for them the food they require, I plead that it is a better plan to give relief trustfully and privately to a parent—better for the strengthening of the family system amongst us, more considerate towards the parent, more effectual in the long run for the children—than to distribute dinner tickets to selected children in schools.

Can hungry and half-clothed Children be efficiently educated?

BY

MRS. ANNIE BESANT, M.L.S.B.

The two positions that may be taken with regard to the child in the family and in the State are :—(1) That the right of the parent over the child is supreme, and that no State is justified in interfering with that right; and (2) that the child is the future citizen of the State, and as such it is to be regarded by the State of to-day, that the rights of the State for that standard are supreme, and that it may interfere between parent and child, forcing a bad parent to perform at least a minimum of duty, and where the parent does not do so, stepping in itself to supply the needs of the child. With regard to such things as may make it useful to the State, we have decided that all children shall be efficiently educated, and, on righteous grounds, we no longer permit a bad parent to ruin his child by not allowing it to go to school. It is a function of the State to defend its small members against unfair oppression, as when the father and mother keep a child in a condition of ignorance, and so make it impossible that the child can become a useful member of the State. That is to say, we do put the interests of the State above the ties of the family, in order that the child may be able to fulfil the duties which are to be put upon it. Starting from the first grant, which was given by Parliament to the children, we have come to the time when education is not a grace given to the child, but a right which the child can take. We made education free by grace some years ago, for the remission of fees is really making education free for a part of the community. It is now no longer free by grace, but by right. The question is, Is that education to be rendered useless extravagance by giving it to children whose physical condition makes them incapable of assimilating that knowledge? We give it to them for the sake of the State, and it is therefore important that it should be made as useful and efficient as possible. We cannot teach a half-starved child. We may force it to sit and listen to the instruction, but it will be just as wise after it as before: and it is quite certain that children come to our schools in a physical condition which makes their reception of the subjects dealt with an impossibility. It is starvation which makes them so restless that they cannot keep still on the benches. If the child is to be a fit recipient for instruction, it must have its body in a fairly healthy condition; a child that is half-starving is stupid, or is blamed for that fault when the so-called stupidity is merely a physical condition of its brain which makes it unable to understand. If we take the schools in which the children have been supplied with proper food for one or two years, the same children having been left to starve before, we shall find that the results of a Government examination will have undergone a remarkable change. In Sir Henry Peek's schools in one year, during which a daily dinner had been supplied to the children, every child

passed the Government examination. I do not mean to say that giving food will make a child pass an examination, but I do say that starving it will make it unable to pass any examination at all. What is called over-pressure in our schools is generally under-feeding. Pains are taken to prevent the education being too hard to bear, but all this will be no good unless the children are in a fit physical condition to receive the instruction given by the teacher. If we were to ask the teachers what was their greatest difficulty, we should find it was the under-feeding of the children. In Mr. Davies' paper an objection, which was the commonest of all, was raised, namely, "Any action which "takes the children off the parents' hands and makes them the immediate "objects of relief is to be deprecated. It is a matter of supreme "importance for our social well-being that the family relations should "be maintained in health and strength, that parents should be encouraged "to care properly for their children, and children in turn for their "parents." And he then asks, "What, then, is to be done when parents "spend their money in drink, and leave their children only half fed?" That was a difficult question to answer, and he has not tried to answer it at all. My reply would be that he could not maintain his position, once the State had interfered and imposed burdens on the child which it could not bear at all. A half-starving child in the gutter would get dragged up somehow, more or less; but when taken away, a mental strain was put upon it, a burden which it was unable to bear. As regards the parent, all further responsibility would be taken from him. That child in the home of the very poor is a machine for making money, and out of the pennies which it begged, stole, or earned, a farthing would now and then go for its own food. If the child were taken away, the father would be deprived of his natural right to live upon part of the labour of his child. They had no right to punish the child because the parent was evil.

L'Enfant Pauvre.

PAR

THÉOPHILE ROUSSEL, Sénateur, Paris.

L'article du Programme du Congrès qui a pour l'objet "L'enfant "dans des conditions anormales, comprend les *enfants pauvres et les* "*enfants à tendances criminelles ou placés dans un milieu criminel*, "c'est-à-dire, deux catégories très différentes au point de vue des "mésures d'hygiène morale et physique que chacune d'elles réclame "pour changer leur condition et leur donner une valeur sociale suffisante "pour qu'ils deviennent des êtres utiles à leurs semblables et à eux-"mêmes."

Pour *l'enfant pauvre*, proprement dit, à moins qu'on ne veuille parler d'une société idéale, il semble que sa condition n'est pas anormale, car l'histoire nous montre la pauvreté, la misère même, comme un fait si constant dans les sociétés de tous les temps, qu'elle paraît être un fait naturel, une condition normale, et comme un des éléments constitutifs de toute grande agglomération d'hommes. Il n'est pas moins vrai que l'état de pauvreté a des influences si nuisibles au développement de l'enfant, physiquement et moralement, que les sociétés civilisées ont le devoir de les combattre non seulement par les forces de l'initiative privée et des associations charitables, mais par l'intervention de l'autorité publique et des lois.

Pour le nouveau né, le nourrisson, l'enfant du premier âge, la pauvreté qui assujétit sa mère au travail hors de son foyer a pour conséquence la privation du lait et des soins maternels, c'est-à-dire, de ce qui est le plus nécessaire à l'existence humaine à ses débuts.

Contre ce mal, qui s'est considérablement aggravé avec les progrès de l'industrie moderne le programme du Congrès semble opposer les *crèches*. Partout en effet où des mères ouvrières veulent faire un effort pour donner à leur enfant leurs soins et le temps que le travail n'absorbe pas, une crèche bien installée, bien surveillée, est un grand bienfait. Ceux qui ont prétendu, en théorie, qu'elle n'est qu'un mal nécessaire ne pourraient pas soutenir, en fait, qu'elle est, pour un grand nombre d'enfants malheureux, le seul moyen d'échapper aux dangers qui rendent si précaire la vie de l'enfant du premier âge.

Une autre anomalie funeste au premier âge a pris un développement considérable, surtout dans les grands centres de population : je parle du nourrisage mercenaire et de l'allaitement artificiel qui ont pris la place de l'allaitement maternel. Il s'est développé ainsi une industrie malsaine dont les effets sur la mortalité infantile ont amené le vote par le Parlement français d'une loi ayant pour object "*la Protection des* " *enfants du premier âge et en particulier des nourrisons.*" D'après l'Article 1er de cette loi : "*Tout enfant de moins de deux ans, qui est* " *placé, moyennant salaire, en nourice, en sevrage, ou en garde, hors* " *du domicile de ses parents, devient, par ce fait, l'objet d'une* " *surveillance de l'autorité publique, ayant pour but de protéger sa vie* " *et sa santé.*"

Ce controle protecteur, organisé aujourd'hui dans presque tous les départements, suit le nourrisson dans tous ses déplacements; une inspection médicale particulière surveille et dirige son hygiène ainsi que les pratiques des nourrices. Les Rapports présentés chaque année aux conseils généraux ont mis hors de doute l'efficacité de cette loi et ses résultats déjà considérables.

Cette question m'a paru mériter d'être ajoutée à celles qu'indique le Programme du Congrès, parceque d'autres pays que le mien, souffrant, à des degrés variés, du même mal, gagneraient à l'organisation d'une protection légale de l'enfant livré au nourrisage mercenaire.

L'enfant pauvre, en particulier celui des filles-mères pauvres est devenu, en France, l'objet de mesures protectrices que je dois signaler encore à cause de l'excellence des résultats pour son hygiène physique

et morale; je parle du service des *secours temporaires* accordés par l'assistance publique aux filles-mères, mères pauvres qui nourrissent et gardent près d'elles leur enfant, et accordés aussi dans plusieurs départements aux mères légitimes dont l'indigence pourrait amener l'abandon de l'enfant.

L'origine du *secours temporaire* se rattache à la suppression d'un autre service que l'Angleterre et les pays germaniques n'ont pas admis dans leur assistance, que la Belgique a supprimé avant la France, et dont la France se sert encore, le service de *Tours*. Les services que le Tour a rendus jadis en prévenant l'abandon des enfants qu'on ramaissait, vivants ou morts, aux portes des églises, sur les places publiques, ou le long des chemins, étaient compensés par des abus vainement combattus, sous l'ancien régime à l'aide de mesures plus ou moins sévères. Une loi, le Décret-loi, du 19 janvier 1810, a eu pour objet d'arrêter la multiplication des Tours, de régler leur emploi; mais l'expérience des 20 années qui ont suivi, à côté d'un avantage incontestable du Tour, la seul, celui de protéger le sécret des mères, filles ou femmes, réduites à la necessité d'accoucher clandestinement, a révélé des inconvénients tels pour la vie, la santé et l'avenir de l'enfant que l'emploi de cette machine tournante, condamné par l'opinion, a été successivement abandonné par tous les Conseils Généraux des Départements.

Mais supprimer le Tour ne suffisait pas, il fallait le remplacer par des mesures d'assistance propres à atteindre le double but en vue du quel le Tour avait été jadis imaginé. On peut dire aujourd'hui que si les efforts des administrations d'assistance publique n'ont pas obtenus partout ce résultat, on est en présence, dans plus d'un département, notamment celui de la Seine d'un système de mesures préventives qui sauvegarde à la fois le sécret des mères qui en ont besoin et l'intérêt supérieur de la vie, de la santé et de l'éducation de l'enfant. Ces mesures sont:—1°. La Maison de Maternité avec le sécret absolu. 2°. Le Bureau d'Admission de l'Enfant sans enquête. 3°. Le secours temporaire aux mères indigentes qui ne cachent pas leur maternité et gardent leur enfant.

Ce dernier moyen d'assistance s'est étendu de plus en plus dans la pratique de l'assistance publique, à mesure que l'expérience mettait en évidence cette vérité de fait, que pour la très grande majorité des filles-mères la question principale n'est pas celle du sécret, mais celle d'un secours pécuniaire assuré, suffisant pour qu'elle puisse supporter les charges de la maternité. Ce secours suffit en effet presque toujours pour rendre au sentiment maternel de la fille-mère pauvre toute sa force naturelle et les Annales des Services publics des *Enfants secourus* est aujourd'hui riche de faits qui prouvent que la présence de l'enfant naturel au foyer maternel contribue à rendre ce foyer respectable, souvent à y ramener le père et faire naître en lui des sentiments dont le mariage et la légitimation de l'enfant sont le fruit. Enfin, par ce bienfait capital de rattacher l'enfant à la vie de famille par un lien destiné à se fortifier de plus en plus, le *secours temporaire* assure à l'enfant pauvre les meilleures

conditions pour son développement physique comme pour son hygiène morale.

Le Programme du Congrès touche ensuite aux questions de *l'éducation de l'enfant pauvre, par l'état, par les institutions philanthropiques ;* celle de sa *nourriture*, de son *vêtement* à l'école, et celle de son placement en pension (*boarding-out*) chez des particuliers. Le Règlement du Congrès ne permet pas d'entrer dans les détails, et je me tiendrai aux principes d'après les quels la solution des ces questions doit être réglée.

Je ferai toutefois une observation : le Programme, comme c'était naturel ici, vise plus particulièrement les institutions anglaises, dont l'histoire, en ce qui concerne l'enfant pauvre est pleine d'intérêt et d'utiles leçons pour tous les pays.

L'Act célèbre de la 43e anné du Regne d'Elisabeth (1602) qui a fait de l'assistance des indigents une charge obligatoire des paroisses ne contient pas des dispositions particulières pour l'enfance ! L'enfant pauvre prenait sa part à *l'out-door* ou à la *indoor-relief*, c'est-à-dire, au le secours à domicile ou au *workhouse*, concurrement avec ses parents, et le temps n'est pas éloigne où ce triste refuge de la misère ne contenait pas d'autre compartiment réservé à l'enfant que celui d'une école pour les heures de classe. Pour l'enfant déguenille laissé dans les rues, *l'Arab-Boy*, une amélioration sérieuse a commencé par la création d'écoles (*Day Schools, Ragged Schools*), qui lui donnent pendant le jour un asile, l'instruction, la nourriture et des vêtements. Quant à l'enfant livré à la promiscuité du *workhouse*, malgré les prescriptions d'un Act de 1834, qui faisait une règle aux paroisses de séparer entr'elles les diverses catégories de la population admise à *l'indoor-relief* le changement de situation des enfants n'a commencé qu'à la suite du mouvement qui a grouppé les paroisses en circonscriptions d'assistance plus grandes sous le nom d'*Unions* et les *Unions* en circonscription plus grandes encore appelés *Districts*. Des ressources financières suffisantes ont permis dès lors, de faire sortir les enfants de l'enceinte des *workhouses*, de créer pour eux des écoles *séparées* (*separate schools*), et l'on a vu s'élever ces immenses écoles de *District* contenant la plupart plus de 800 enfants, quelque unes presque le double, et dont les inconvénients principaux viennent de leur immensité même.

Le texte du programme invite à opposer le *systême du Poor Law District Schools*, au systême du *boarding-out*, improprement traduit dans l'édition française par le mot *pensionnat*, et qui est le systême du placement en pension chez des particuliers, dans des familles agricoles ou industrielles. Cette question est aujourd'hui jugée. En France, où le placement des enfants à la campagne est la pratique traditionnelle de l'assistance publique, elle l'est depuis longtemps, et en Angleterre même l'expérience déjà longue du régime des *Separate or District pauper Schools* ne peut laisser de doute à personne. Les épidémies d'ophthalmies et les maladies contagieuses qui sévissent, par prédilection, sur ces énormes agglomérations d'enfants pauvres ; les difficultés pour un apprentissage professionnel suffisant, enfin l'énormité des dépenses ont

fait naître un nouveau courant d'opinion qui depuis un certain nombre d'années, après avoir entrainé les meilleurs esprits, semble avoir convaincu tout le monde. Un des hommes qui se sont le plus occupés de ces questions, M. Francis Peek, démontrait en 1885, que pour l'éducation d'un enfant à l'école de district, les contribuables payent au moins double de ce qu'ils payent pour l'éducation de leur propre enfant et Lord De la Warr, dans le Parlement, comparant le systême de ces écoles à celui du *boarding-out*, montrait que dans le premier la dépense moyenne d'un enfant par semaine est d'environ 10 shellings, tandis qu'elle ne dépasse pas 5 shellings dans le second. De pareilles différences financières, s'ajoutant à celles non moins évidentes des effets des deux systêmes sur le développement physique, moral et professionnel ne permettaient plus aucun doute, et assuraient au *boarding-out* la faveur et le succès dans un pays aussi pratique que la Grande Bretagne.

C'est toutefois sous la forme la moins advantageuse qu'a commencé l'application de ce systême par l'envoie d'enfants en placement dans les colonies, au Canada, ou même aux Etats-Unis. Plusieurs millions d'enfants ont pu trouver ainsi, au loin un sort meilleur que celui qu'ils auraient eu au sortir des *District Schools*; mais on s'est aperçu des inconvénients de ces émigrations qui étaient d'ailleurs sans influence sur le pauperisme. L'Écosse a montré la première que la vraie pratique du *boarding-out* c'est le placement, à l'intérieur du pays, dans des *homes* bien choisis et régulièrement visités. Les succès de cette pratique ont été à plusieurs reprises constatés dans les Chambres Anglaises avec l'expression du désir que le systême reçoive la plus grande extension possible, et, suivant les expressions de Lord Aberdare entr'autres, soit appliqué à tous les *enfants "qui lui sont propres"* (*who are proper subjects to it*).

Je lisais dans une des publications si utiles du Howard Association qu'un Visiteur d'Enfants du comté d Nottingham rendant compte de sa mission disait :—"En parcourant différents villages j'ai été frappé du "développement à la fois physique et moral de ces enfants. La vie "saine, au grand air, qu'ils mènent dans les champs produit les plus "surpassantes transformations, faisant de quelque chose de triste et "pénible à voir, de jeunes êtres du plus heureux aspect, qui con-"sidèrent comme leur maison paternelle les *homes* qui les ont reçus et "sont considérés par les nourriciers qui les gardent comme leurs "propres enfants." Cet agréable et consolant spectacle est celui que les services d'enfants assistés de France nous donnent depuis longues années dans l'ancienne patrie du *boarding-out*.

En résumé, de l'expérience aujourd'hui décisive partout il ressort les conclusions suivantes :—

Pour l'hygiène de l'enfant pauvre, pour son développement physique et moral et son éducation professionelle, le régime le meilleur est la vie de famille lorsque la famille est honnête; si la pauvreté fait obstacle à l'education de l'enfant c'est par le secours à domicile qu'il doit y être pourvu, secours en vêtements, nourriture, livres, etc. Là où la famille n'existe pas ou si le foyer maternel est éteint, c'est au *boarding-out* qu'il

faut recourir, c'est-à-dire, à un placement de l'enfant dans une famille honnête où il retrouvera un foyer domestique et recevra l'éducation commune à la masse laborieuse et saine de ses concitoyens.

L'internat, dans le sens français de ce mot, c'est-à-dire toute agglomération d'enfants dans un établissement en vue de leur éducation a beaucoup perdu de son ancienne faveur pour l'éducation des enfants riches; pour les pauvres il pourra rester encore trop souvent un mal nécessaire; mais il devra toujours être considéré comme un pis aller, même lorsqu'il s'agit d'un établissement de l'état. Dans les établissements charitables le mal est plus à redouter encore. D'une grande enquête faite en France, il y a dix ans, sur la demande d'une commission du Sénat dont j'avais l'honneur d'être le Rapporteur, il est ressorti, que les orphélinats et autres établissements de charité consacrés à l'enfance, même lorsque le pur esprit de charité préside à leur création, doivent tous être soumis à la surveillance de l'autorité publique; que dans un très grand nombre, l'éducation professionnelle est défectueuse, et la préparation à une vie de travail utile, insuffisante; enfin et surtout que dans beaucoup de ces institutions, l'éducation proprement dite est complètement subordonnée au profit de l'établissement qui ne vit que par l'exploitation de la main d'œuvres des enfants.

Ces conclusions que j'ai l'honneur de soumettre au Congrès sont les résultats d'observations incontestables; leur importance sociale n'a pas besoin d'être demontrée; j'espère qu'elles ressortiront davantage des délibérations du Congrès.

DISCUSSION.

Dr. Chalmers (Lanarkshire) referred to the prevalence of thriftlessness and crime as being quite unaffected by the amount of earnings of parents. Either or both might be regarded as crime, but the children should not be made to suffer in consequence. Food and clothing were prominent necessities for the children, and we should not deny them.

Dr. Pankhurst said that the paper of Mr. Davies, and the eloquent address of Mrs. Besant, had brought before the Congress a most important and momentous aspect connected with the education of the young. For more than 50 years the country has laboured to make elementary education universal, compulsory, and free. Now we are confronted with the question of providing for the young thus compelled to be at school food and clothing. The case for this provision is made out. Two objections are urged. One is that this course will relieve bad parents of their duty, while, on the other hand, if the children of poor parents get this provision, the parents of children who can pay for this provision will escape. Though I think the question of food and clothing stand on the same ground of principle, yet the food question is simpler.

I venture to suggest that it is not the right course to give the money for the food to the parents. The food should be supplied at the place where the education is given at the public charge. Again, there ought to be no selection of the children to be fed on the part of the public

authorities. Any selection should be self-acting. The provision should be open to all the children. All the children should be invited. As this provision is put on the ground of its necessity for the children, so it should be extended as far as the necessity extends.

If the public reasons for this provision of food were displayed in full statement in the school, then it should be left to the conscience and morality of the children of parents who can pay for their food to accept or decline this provision. For myself, I am for the provision of food and clothing to all children who need it, in so far as they are in compulsory attendance at public elementary schools.

Mr. Lloyd Baker said:—My experience is taken from country schools, but I think that human nature is the same everywhere. Mrs. Besant wishes that children should know that, when their parents neglect them, the State will take care of them. I fear that, when they grow up, they will feel that the State will provide for their children, and others will feel it also. Improvident marriages will certainly increase. Mrs. Besant desires that we should carry our views to a logical conclusion. If her views are carried to their conclusion, the State will have to provide for every need, until our children will be like those French chickens, which are hatched in an incubator, brought up by an artificial mother, and are unable to rear their young, or even feed themselves, so that they have to be fed by a machine, and are only fit to be killed.

Lord Meath remarked that there was a great deal to be said on both sides of the question, but that, in the main, he believed in Mrs. Besant's proposition. He proposed that dinners should be supplied in all schools, but that payment should be demanded for them of the parents. If the parents did not pay, the school authorities should inquire the reason why the payment is not forthcoming; if it was owing to poverty, the parent should be declared a pauper, and the dinners be paid by the poor-law authorities, the parents naturally suffering the penalties of pauperism; if it was owing to drunkenness or criminality, the parents should be considered as criminals, and be punished for neglecting to pay the cost of the dinner provided by the authorities for their offspring.

Professor James Mavor described the institution of the Caisse d'Ecole, in Paris, where dinners and clothes are sold to the children of the board schools and given to the destitute; he also remarked that the words "home" and "family" did not apply in the cases of destitute children.

Dr. Holden (Preston) entirely supported Mrs. Besant's resolution, because, having had a long experience amongst working people in a manufacturing town, he knew the great difficulty found in families where the wife is compelled to go to work, to provide a good nourishing mid-day meal for the children, and the tendency to substitute a makeshift dinner of tea and bread, which is totally insufficient, tending to produce a delicate childhood and ill-developed maturity.

Friday, 14th August 1891.

The Chair was successively occupied by:—
The PRESIDENT;
Dr. J. LANGDON DOWNE.

The Care and Treatment of Epileptic, Mentally Feeble, and Imbecile Children.*

BY

FLETCHER BEACH, M.B., F.R.C.P., Medical Superintendent of the Darenth Asylum for Imbecile Children.

Three perfectly distinct classes of children are here referred to, and the care and treatment of each should proceed on different lines. With respect to the first class, little has yet been accomplished. Besides the home for epileptics at Maghull, which was started, I believe, by Dr. Alexander, and a home or two carried on by private persons, nothing has yet been done in England for these cases. Some time ago the Charity Organization Society suggested that workshops should be established for them, where they could go to work during the day, returning home at night, but the suggestion was not carried out. I would propose that homes should be provided for them, where they could be cared for and treated mentally and physically, and where proper medical treatment could be pursued. It is well known that, by the exhibition of suitable drugs, epileptic fits in the young can to a great extent be lessened, and in some cases the convulsions entirely disappear. Many of these cases attend the out-patient departments of children's hospitals; but as soon as the treatment begins to take effect the parents discontinue bringing them, and the patients cannot afterwards be traced. Besides this objection, there is the fact that no mental or physical treatment is possible. Children subject to severe epileptic fits will not be admitted to an ordinary school, and are thus debarred from participating in the education so necessary for their mental condition.

At the Bicêtre, in Paris, epileptics are trained in the same institution as idiots and imbeciles, but this has been objected to in England, and rightly so, I think, as the mental condition of epileptics is usually far above that of idiots and imbeciles, and the massing of the former with the latter class will not improve the imbecile, and is more likely to cause deterioration in the epileptic. If a home were started for them, education suited to their condition could be pursued, and they could be

* In this paper reference is made especially to the children of the poorer classes, and not to those of the middle and upper classes, who are able to make provision for their offspring.

taught different trades, while at the same time drugs, which are known to diminish the fits, could be exhibited. Some may object to homes being specially provided, but if these children are simply sent to day-schools, where special treatment is carried on, it will be impossible to supervise their diet, in itself an important matter, to establish cleanly habits, and to see that they sleep in rooms sufficiently aired. Besides this, it will be impossible to keep them from possible states of excitement in their own family, and to see that the medicine prescribed is given. Institutions, such as I have referred to, might be supported by voluntary contributions, and guardians should have the power of sending epileptics to such institutions in the same way as they do the blind, deaf, and dumb.

The care and treatment of the feeble-minded is a much larger question, and committees of the Charity Organisation Society and British Medical Association have for some time been working at it. Official bodies have also had the question before them. The Royal Commission on the Blind, Deaf, and Dumb, &c. came to the conclusion: "That with regard to 'feeble-minded' children, they should be "separated from ordinary scholars in public elementary schools, in "order that they may receive special instruction, and that the attention "of school authorities be particularly directed to this object." It is interesting to know that the School Board of London have adopted this suggestion, and are now making the necessary provision for such cases.

In 1888 the Psychological Section of the British Medical Association appointed a committee to investigate the physical condition of the child population. Fourteen schools, containing 5,344 children, were visited, and notes were taken of 809. Mental dulness, combined with other abnormalities, were observed or reported in 231 cases. Since that time a further investigation has been made by Dr. Warner, in conjunction with Drs. Rogers and Rayner, or with the medical superintendents and teachers at the several schools, and 50,000 children have passed under observation. Notes have been taken of 9,186 cases. Union district, certified industrial, public elementary, and some other schools were visited. An analysis of the cases seen has been made by Dr. Warner, who has classified them, showing the co-relation of mental dulness, as reported by the teachers, with defects in physical development, abnormal nerve-signs, and low nutrition. 234 were said to be mentally exceptional, and full particulars of these are given. I have appended to this paper a table kindly supplied to me by Dr. Warner, giving various particulars, and showing the number of the mentally dull and those suffering from other abnormal conditions in the 50,000 who passed under observation.

There is no doubt that for feeble-minded children special instruction, similar to that which the London School Board contemplates, should be provided. There is not so much objection to the education of children of this class at day schools, as in the case of epileptics, and though treatment in institutions specially erected would probably be attended with better results, it may perhaps be well at first to make a trial in day schools, where instruction suitable to their mental capacity

can be obtained. There is a precedent for this, for in Norway and Germany auxiliary schools have for some time been established for the very purpose of training mentally feeble children. Into these schools are drafted those who are quite unable to follow the teaching in the national schools, whereas in the auxiliary schools instruction adapted to their powers of reception is given by teachers experienced in the methods required to call out the faculties of such cases. The teaching is arduous, and not more than 20 children should be placed in one class.

There is another point which requires to be considered. If the teaching of the feeble-minded is neglected, not only do the girls, as they reach maturity, lead immoral lives, but many of them, as well as the males, swell the ranks of the criminal population. Some time ago the National Vigilance Society made inquiries as to the number of feeble-minded girls and women in workhouses and infirmaries, and they found that, though their returns were incomplete, during the year 1889 no less than 715 weak-minded women passed through 105 workhouses, and that at 56 workhouses the approximate number of such women leading immoral lives was 366. The Reformatory and Refuge Union have also considered the question, and both this body and the Vigilance Society are anxious, not only that provision should be made for the adult feeble-minded, but that weak-minded children should be educated and trained. There is no doubt that the immoral and criminal tendencies of weak-minded adults are largely due to want of will power and moral control, and there is a hope that the number of such cases may be lessened by educating and training the weak-minded when young and at a time when the character is plastic and can be easily moulded. Personally, I am in favour of detaining the weak-minded adults in an institution where they can be suitably employed and where they may lead happy and useful lives. At present their condition is often most wretched, and details of cases which have recently come under my notice show that many of them live a neglected and degraded life, and are treated more like beasts of burden than human beings. To allow these women to be at large is simply to increase the number of weak-minded and imbecile children from year to year, and therefore from a merely financial point of view it would seem cheaper to detain them and prevent them from mixing with bad characters in the outside world. If, however, you do not care to go so far as this, then I say it would be wise to take advantage of the Act of Parliament which was passed in 1867, by which "Guardians may provide for the reception and maintenance "and instruction of any adult pauper being blind or deaf and dumb, in "any hospital or institution established for the reception of persons "suffering under such infirmities, and may pay the charges incurred in "the conveyance of such pauper to and from the same, as well as those "incurred in his maintenance support, and instruction therein." All that we have to do is to ask the Local Government Board to extend the facilities now provided for the blind, deaf and dumb to the feeble-minded. To do nothing involves a very great expense—to do something a much less one.

Passing now to the care and treatment of imbecile children, I would remark that the accommodation now provided for them is markedly deficient. The number of idiots and imbeciles in England and Wales returned in the householder's schedules at the census of 1881 was 32,717, but the returns are undoubtedly far below the actual number, owing to the disinclination of parents to conclude that their children are so far affected as to render it necessary to return them as idiots or imbeciles. Of these at least 7,000 are between 5 and 20 years of age, the period during which training and treatment is best undergone and, no doubt, the returns of the late census will add 1,000 or 2,000 more to the number. Accommodation, however, is at present only provided for about 2,400 of these, so that there are at the lowest computation 4,000 for whom provision should be made. Many of these are kept in workhouses, where there is no attempt at training, or they are confined in the wards of lunatic asylums, where, not only is no improvement possible, but the patients actually suffer; they are bewildered and frightened by the noise of those who are acutely maniacal, and they imitate the bad habits of the lunatics with whom they are associated.

From time to time committees have considered this subject. Some time ago a Special Committee of the Charity Organization Society went fully into the matter, and recommended that schools for paupers idiots and imbeciles should be built, capable of accommodating 500 children, and that for those above the pauper class, institutions supported by voluntary contributions should be provided. Unfortunately no action followed. In 1887 another committee considered the matter, especially with reference to the non-pauper cases, and an effort was made to obtain funds under the City of London Parochial Charities Act of 1883. Section 14 appeared to warrant the application for a grant of funds for the purpose, for it refers to "the promoting the education of the poorer inhabitants of the metropolis," and goes on to state, "and generally to "the improving, by the above or by any other means which to the "Commissioners may seem good, the physical, social, and moral "condition of the poorer inhabitants of the metropolis." A formal application to the Charity Commissioners was made, and though the deputation was courteously received, no grant was obtained. There is no doubt that more voluntary institutions should be erected, and buildings for paupers should be constructed, either in the grounds of the existing lunatic asylum, or, what is better, quite separately therefrom. In the more populated counties, such as Lancashire, Yorkshire, &c., there would no doubt be a sufficient number to warrant the erection of a separate institution, while in centres purely agricultural, two or three counties could combine together to build an asylum. At any rate, every county or combination of counties should have its idiot as well as its lunatic asylum.

It may perhaps be interesting to relate shortly the kind of training which is given in institutions for idiots and imbeciles. We have, firstly, to strengthen the body and alleviate its defects, and, secondly, to undertake the special teaching of the mind. The first and most important part of the training is that which concerns the physical condition. The

muscles which are wasted must be nourished by calling their functions into activity, and the want of co-ordination, evidenced by the entire absence of the ordinary precision of muscular movement, has to be corrected by properly applied exercises. The automatic movements, due to the want of the controlling power of the will, must be replaced by others upon certain definite plans. Then, the muscular system being strengthened, the hands have less difficulty in performing any simple act, locomotion is improved, dribbling from the mouth disappears, the eyes wander less restlessly, and the listlessness and, to a great extent, the inertness disappear. The moral treatment goes on side by side with the physical and mental treatment. Obedience must be taught, and efforts made to impart good temper and affection. The child has to learn these good qualities through the agency of the teachers and attendants, who have to use every effort to improve the moral qualities of those confided to their care.

The intellectual training in the lowest class commences by the cultivation of the senses, and as the tactile function is the most important we commence by educating the sense of touch. This may be trained by use of nailboards, by fitting square, circular, and oblong pieces of wood into corresponding depressions, by threading beads, building with bricks and numerous other exercises too numerous to mention. The sense of sight is educated in colour by the aid of paper of various colours which the child should match, and by coloured cups and balls which he should pair; in form, by the use of the squares, circles, &c. before mentioned; in dimension, by the use of pieces of wood of different lengths; and in the notion of distance by making the pupil separate objects from one another, and then take measurements from point to point. The sense of hearing is trained by teaching the child to discriminate between the various sounds presented to his ear, or by the aid of music, of which nearly all imbeciles are fond. The senses of taste and smell are awakened by a series of experiments, and the qualities of objects thus ascertained. In every case we proceed from the simple to the complex, teaching ideas by the use of concrete forms and not by abstract notions. Having educated the senses, we proceed to higher branches of learning, giving instruction in the alphabet, reading, spelling, writing, arithmetic, drawing, the idea of weight and the value of money. When some progress has been made, instruction in tailoring, shoemaking, carpentering, mat and brush making, and gardening for the boys, and in domestic work and sewing for the girls proves useful, alternating the industrial with the purely intellectual training. Varied amusements have, of course, to be provided.

In conclusion, I would venture to express the hope that the result of this Congress may be to direct attention more forcibly to the three classes of cases, which are the subject of my paper, and to incite public bodies to make further provision for the improvement of their physical and mental condition.

GENERAL RETURN from an INQUIRY into the CONDITION of 50,027 CHILDREN.

Cranial abnormalities	2,576	Eye movements defective	1,283
Ear defects	1,315	Head balance weak	538
Epicanthics	898	Hand weak	1,219
Palate defective	1,331	Hand nervous	1,066
Other defect of body	1,553	Finger twitches	706
General balance weak	374	Lordosis	463
Expression defective	1,168	Other abnormal nerve signs	668
Frontals overact	1,616	Nutrition low	2,003
Corrugation	239	Eye cases	1,473
O. Oculi relaxed	865	Mentally dull	3,679*

* Children feeble or abnormal in mental status are included here.

The Care of the "Mentally-feeble" Child (as distinguished from the "Imbecile").

BY

G. E. SHUTTLEWORTH, B.A., M.D., Medical Superintendent, Royal Albert Asylum, Lancaster.

I have ventured to select from the official programme of Section IV. of the Congress the terms used to designate two classes of imperfectly constituted children, and to place them in contradistinction, in order to offer a few remarks upon the care of those designated "mentally-feeble."

Presuming that the term "imbecile" is intended to cover the case of the "idiot," and thus to comprehend the grosser forms of mental defect, I take it that the term "mentally feeble" is intended to be applied to those children whose mental endowments are so poor, or so peculiar, as to render them unfit for the ordinary curriculum of the public elementary school, though they may not be disqualified for family life at home.

It is common enough in upper and middle class circles to hear of some unfortunate who is the "fool of the family," but who, nevertheless, thanks to special educational efforts on his behalf, ultimately becomes a very decent member of society. Amongst the more necessitous classes it is of course only to be expected that mentally-feeble children should be frequently met with; but for them no special educational provision has, until quite recently, been made in this country. Having myself, during the last seven years, taken such opportunities as presented

themselves of advocating the establishment, in connexion with our elementary school system, of special classes for such exceptional children—notably at the London "Conference on School Hygiene" in 1884,* and at the "Manchester Conference on Education under Healthy Conditions" in 1885—† I rejoice to find that the London School Board is about to inaugurate "classes or schools for children who by reason of "physical or mental defects cannot be properly taught in the ordinary "schools." This is, so far as I know, the first attempt to minister to the special needs of the "mentally-feeble" in connexion with the public elementary schools in this country; though for some years past arrangements have made for this purpose in Norway, Germany, and some of the Swiss cantons. I may perhaps be allowed to quote from a memorandum drawn up for the use of the Royal Commission on the Blind, the Deaf and Dumb, &c., the following paragraphs as to special classes for abnormal children in Norway, which I visited in 1887.‡

"In Christiania and in Bergen special classes are organised, in connexion with the public elementary school system, for the separate instruction of such pupils as are found incapable, in consequence of nervous or mental "abnormality," of following the ordinary school curriculum.

"In class rooms forming part of a large public elementary school in the east of Christiania I found 28 'abnormal' children being instructed by three teachers. A few children suffered from defects of sight or hearing only, but the majority furnished evidence of mental or nervous defect, not, however, amounting to actual idiocy. The organisation of the classes had been entrusted by the school board to Herr J. A. Lippestad, the esteemed Director of the Institution for Imbeciles at Thorshang, Christiania, and the teachers had been trained by him, one of those I saw being also engaged at the institution. The methods used were those found effective in the improvement of imbecile children, viz., exercises to fix the attention, to quicken the perceptions by cultivating the senses, to overcome nervous irregularities by specially adapted drill, and to promote industrial usefulness and moral control. The teaching appliances comprised ample material for pictorial, object, and practical lessons, the ratio of teachers to pupils being about 1 to 10 (instead of as in the ordinary school 1 to 30), allowing of a fair amount of individual attention. Herr Lippestad gives a generally favourable account of the results attained. Many of the pupils, after special instruction for a year or more in these classes, are enabled to join the ordinary school, whilst some complete their education in these classes to the standard required for 'confirmation' (which in Scandinavian countries is regarded as an essential preliminary to earning a livelihood). The drawbacks to more complete success, according to Herr Lippestad's

* *See* "Health Exhibition Literature," Vol. XII., p. 560.

† *See* "Proceedings of Conference on Education under Healthy Conditions, Manchester, 1885, p. 219.

‡ *See* Appendix, Report, Royal Commission, p. 370.

experience, are the comparatively short time spent by the children each day under the influence of their teachers, and the depressing influences, both moral and physical, of home life in the case of the more necessitous.

"In Bergen the auxiliary classes were under the care of Herr Soethre, Principal of the Institution for Imbeciles at Ekelund, and the instruction is given by teachers from that institution. Thirty-five children out of 5,000 attending the public elementary schools are at present in these auxiliary classes. The classes are held from three to six each afternoon in premises apart from the ordinary school. Four teachers are provided, and the capitation grant (which in this case covers the expenses of school premises and apparatus) is 125 kröne per annum (equivalent to about 6*l.* 19*s.*). In the highest class the pupils were able to read, to write from dictation, and to work sums in the simple rules of arithmetic."

From correspondence with Herr Lippestad I learn that the Christiania classes were established in 1874, and that the average attendance is about 90 children (from the 15,000 attending the public elementary schools). The classes are held in the afternoons only in two of the board schools selected so as to be as convenient as practicable for access from the homes of the pupils. The annual cost is about 6*l.* 15*s.* each pupil. Herr Lippestad divides the pupils according to results, into four categories, viz.:—

1. Those who after two or three years special teaching can be brought back into the ordinary school.
2. Those continuing in these classes till prepared for confirmation.
3. Those for whom these classes are found insufficient. Such, after being tried for a time, are sent to special institutions for imbeciles.
4. Those utterly ineducable, who after full trial are dismissed to their homes.

In Germany, "auxiliary" schools for exceptional children have been established at Dresden, Leipsic, Gera, Hulberstadt, Cologne, and Brunswick. Herr Kielhorn, the able principal of the school at Brunswick, thus describes his objects and methods. "The auxiliary school," he says, "is designed for such children as, after a trial of at least two "years in a public elementary school, have not proved competent for "promotion, so that an equal progress with their schoolmates is "impossible. On the other hand, those children are excluded from "attendance at the auxiliary school who, in consequence of too low "mental capacity, or of too great bodily infirmity, or of insufficient "home care, are better assigned to a special institution. . . . . "In the auxiliary school it is essential to develop by every means, and "concurrently, the mental and bodily powers of the children to the "utmost extent possible. As the teacher must specially adapt himself to "the peculiarities of each child, and having regard to the small capacity "of the pupils, must make sure, by constant repetition of what has "been learnt, the scope of instruction must necessarily be restricted."*

* *See* remarks by author in "Journal of Mental Science," April, 1888. Page 80, seq.

It is notable that the cultivation of the senses, and the training of the hand, form important items in the scheme of instruction.

In the selection of pupils suitable for special schools or classes for the mentally feeble, considerations of a general and physical character come into play. Such children are often the victims of their surroundings; and the lack of judicious home care may grievously interfere with the beneficial effect of special training at school. Mentally feeble children are, frequently, also physically feeble; and retarded mental development often co-exists with a low state of nutrition. Inherited tendencies to nervous weakness account for many cases of irregular or defective mental action. In the cases just referred to, it may be a question whether a boarding institution in the country, with the advantages of medical and hygienic care, would not be preferable to even specially adapted instruction in a town school. Dr. Francis Warner, whose valuable researches as to the condition of elementary school children, as regards their physical development and brain state, are well known, rightly lays much stress upon the skilled interpretation of postures and movements as signs of irregular nerve and brain action. He cites as examples of children "for whom the average education is "not suited, nervous, irritable children with headaches, chorea, occasional "fits, habitual truants, with slight brain defects"; adding that "these "cases could be picked out by a medical inspector, and they can be "taught in ordinary schools, in small class-rooms, under trained "teachers." It would appear that the choice between special class-rooms in connexion with ordinary schools, and special schools set apart for exceptional children, resolves itself into a question of local convenience. Of course regard must be had to the accessibility of the schools or classes from the pupils' homes, and it will probably be found advantageous to adopt the separate school system in large cities, the class system in smaller towns. It will be noticed in the accounts given of the experience both of the Norwegian and the German schools, that some cases of proved incapacity, as well as some whose home circumstances are specially unfavourable, have to be relegated to the institutions for imbeciles, or, as our American cousins prefer to call them, institutions for "feeble-minded children." From my own point of view, considering how much the lasting amelioration of weak-minded children depends upon care out of school, as well as upon instruction in school, I think the institutions will, in many cases, be more effective than the special classes. However, even in such cases, the classes will afford the opportunity of probation, and parents will overcome the reluctance naturally felt to send their children to such institutions when they find that even the special instruction is insufficient. The forthcoming experiment of the London School Board in providing special instruction for children disqualified from the curriculum of the ordinary school by reason of physical or mental defects will be watched with the utmost interest by educators throughout the country; and I trust it may prove so successful as to encourage imitation universally.

Antrag Erhebungen über psychopathisch minderwertige Kinder anzustellen.

VON

Dr. Ludwig Strümpell, Leipzig.
Dr. J. L. A. Koch, Würtemberg.
Dr. Emil Schmidt, Leipzig.
Dr. Ernst Hasse, Leipzig.

Die möglichen Erfolge der Erziehung und des Unterrichts eines Kindes sowohl in der Familie, als auch in den öffentlichen Erziehungs- und Unterrichtsanstalten, hängen vorzugsweise von der *Bildsamkeit* desselben ab.

Die Letztere ist wiederum nicht blos durch die psychische Beanlagung allein, sondern wesentlich auch durch die Gesundheit des Körpers im Ganzen und insbesondere durch die Normalität des Nervensystems und seiner Centralorgane bedingt.

Aus diesem Grunde sind sowohl von Seiten der Medicin, als auch der Pädagogik ernstliche Bestrebungen hervorgetreten, welche bezwecken, ein sicheres Erfahrungsmaterial zu gewinnen, wodurch beiden Wissenschaften ein bestimmtes Urtheil über den thatsächlichen Zustand der heranwachsenden Jugend in Betreff ihrer körperlichen und psychischen Normalität ermöglicht wird.

Auf der Grundlage dieser Kenntniss würde nicht blos die wissenschaftliche Ausbildung beider Doctrinen wesentlich gefördert werden, sondern es würden sich daraus auch für die Praxis im Schul- und Unterrichtswesen höchst nützliche Gesichtspunkte ergeben.

Alle diejenigen Zustände der Kinder, bei denen die geistige Entwickelung entweder durch angeborene oder erworbene, durch dauernde oder auch vorübergehende pathologische Einflüsse von seiten des Körpers, insbesondere der nervösen Centralorgane gestört oder theilweise aufgehoben ist, nennt man *psychopathische* Zustände. Der genannte Zweck ist einem grossen Theile nach am ehesten dadurch zu erreichen, dass die psychopathischen Zustände derjenigen Jugend ermittelt werden, welche zu einer bestimmten Zeit sowohl in den normalen öffentlichen Erziehungs- und Unterrichtsanstalten, als auch in staatlichen und privaten Schulen und Anstalten für zurückgebliebene, nervenkranke und verwahrloste Kinder, sowie im Elternhause ohne eine Anstalt zu besuchen, vorhanden ist.

Um die Beurtheilung des *Grades* der Minderwertigkeit nicht zu sehr in das Ermessen des Zählers (Beobachters) zu stellen, sondern dieses Urtheil dem Verarbeiter des Materials vorzubehalten, müssen sich solche Ermittelungen auf die *Gesammtheiten* der ortsanwesenden Kinder beziehen, auf die gesunden, die minderwertigen und die gebrechlichen, einschliesslich der blinden, taubstummen und eigentlich idiotischen (stärker schwachsinnigen und blödsinnigen) Kinder. Es ist dies schon erforderlich, um die minderwertigen in ihren anthropometrischen

Merkmalen als Ausnahmen gegenüber dem aus der Gesammtheit abgeleiteten Durchschnitt charakterisiren zu können und um bei der Untersuchung die Minderwertigen nicht im Voraus als solche bezeichnen und sie und die Ihrigen verletzen zu müssen.

Mit solchen Erhebungen wäre zunächst an kleineren Orten (Landorten, kleineren Städten) zu beginnen, und nur allmählich und in dem Maasse, wie das Interesse für die Sache sich verbreiten und Uebung und Fertigkeit beim Zählen erlangt würde, wären grössere Kreise in den Bereich der Erhebungen einzubeziehen. Auch dürfte es sich empfehlen, wenigstens anfänglich private Erhebungen zu veranstalten, da man mit solchen Erhebungen hinsichtlich psychiatrischer Fragen an einigen Orten schon besonders gute Erfahrungen gemacht hat.

Im Interesse dieser auch in socialer Hinsicht höchst wichtigen Angelegenheit stellen die Unterzeichneten den Antrag:

Der VII. Congress für Demographie u. s. w. wolle eine aus einem mit der Psychiatrie vertrauten Arzte, einem erfahrenen Pädagogen und einem Statistiker bestehende *Commission* ernennen, deren Aufgabe es sei, mit der Ermittelung der psychopathischen Minderwertigkeiten der Jugend zunächst in kleinen Kreisen, einer Schule, einem Dorf, einer Stadt zu beginnen und dieselbe planmässig fortzusetzen und auszuführen. Auch wolle der Congress die eingesetzte Commission ermächtigen, sich durch Kooptation zu verstärken und für ihre Erhebungen, welche zunächst auf private Willfährigkeit gegründet werden sollen, wenn nöthig, behördliche Unterstützung nachzusuchen.

Um der Ausführung die nöthige Einheitlichkeit zu geben, erlauben sich die Antragsteller das beifolgende Erhebungsformular in Vorschlag zu bringen.

Sollte die zweite Abtheilung des Congresses für die normalen Kinder andere anthropometrische Merkmale feststellen, so bitten wir, diese an Stelle unserer Fragen VII. bis XVI. zu setzen.

Um Doppelarbeiten zu vermeiden, wird es sich jedenfalls empfehlen, die umständlichen psychopathischen Untersuchungen sogleich auch so einzurichten, dass sie für die Anthropometrie der, wenn auch kleinen, Gesammtheiten verwerthet werden können.

Anweisung zur Beobachtung der psychopathisch minderwertigen Jugend.—Es handelt sich bei dieser Beobachtung um Ermittelung derjenigen Individuen, welche zwar nicht geisteskrank, d. h. nicht idiotisch und nicht irrsinnig, welche aber *psychopathisch minderwertig* sind.

Solche (auf das Nöthigste sich beschränkenden) Erhebungen sollen zur Sicherung ihrer Genauigkeit und Zuverlässigkeit zunächst an einigen kleineren und mittelgrossen Orten und zwar unter Mitwirkung von speciell sachverständigen Aerzten, von Lehrern und anderen berufenen (sach- und lokalkundigen) Personen je durch einen Vertrauensmann angestellt werden.

Bei der Ausführung der Beobachtung kommen Zählblättchen zur Verwendung.

Zur näheren Orientirung werden folgende Erläuterungen gegeben:

I. Gezählt werden an einem bestimmten Zeitpunkt *alle* am Orte anwesenden Kinder im schulpflichtigen Alter, gleichgültig, ob sie eine Lehranstalt besuchen, oder nicht. Ausserdem *kann* die Erhebung sich auf diejenigen Kinder erstrecken, welche nach dem Orte zuständig sind (deren Eltern am Orte leben), die aber eine auswärtige Schule besuchen oder in einer auswärtigen Anstalt untergebracht sind. Es empfiehlt sich dies besonders dann, wenn damit die sämmtlichen einer Ehe angehörigen psychopathisch minderwertigen Kinder zusammengefasst werden können.

II. Die Namen der Gezählten werden nicht angegeben. Die Zählblättchen werden aber bei jeder Lehranstalt in fortlaufender Weise numerirt, und es wird sehr gewünscht, dass jeder Zählende für sich ein Verzeichniss der Nummern mit den zugehörigen Namen anlege, damit in Anstandsfällen später leicht Auskunft gegeben werden kann.

III. Auf jedes Zählblättchen wird nur ein Individuum aufgenommen. Der bei dem betreffenden Individuum vorhandene Zustand wird dick unterstrichen, das Nichtzutreffende durchstrichen.

Wo nöthig, sind auch beide Alternativfälle zu unterstreichen, z. B. bei Frage XXI. eventuell anatomisch *und* funktionell.

Kann eine Rubrik nicht mit Sicherheit ausgefüllt werden, so wird ein Fragezeichen beigesetzt.

IV. Unter dem Ausdruck *psychopathische Minderwertigkeiten* sind (nach Dr. J. L. A. Koch, Director der Königlich Württemberg'schen Staatsirrenanstalt Zwiefalten: Die Psychopathischen Minderwertigkeiten, Ravensburg bei O. Maier 1891) *zu verstehen* alle, sei es angeborenen, sei es erworbenen, den Menschen in seinem Personleben beeinflussenden psychischen Regelwidrigkeiten, welche auch in schlimmen Fällen doch keine Geisteskrankheiten darstellen, welche aber die damit beschwerten Personen auch im günstigsten Falle nicht als im Vollbesitze geistiger Normalität und Leistungsfähigkeit stehend erscheinen lassen.

V. Die angeborene psychopathische Minderwertigkeit giebt sich vielfach zu erkennen *körperlicherseits*:

A. Durch *Degenerationszeichen* (stigmata) im *engeren* Sinne. Es sind gewisse *anatomische* Verbildungen, die entweder schon von der Geburt an sichtbar sind oder später mit Nothwendigkeit hervortreten.

Dazu gehören:

1. Disproportionirtheit zwischen den *einzelnen Körpertheilen*, insbesondere zwischen *Schädel* und *Gesicht* und den einzelnen Abschnitten von *Schädel* und *Gesicht*.

Es kann z. B. das Gesicht im Verhältniss zum Schädel zu gross oder zu klein sein oder die untere Partie des Gesichts ist im Verhältniss zur oberen auffällig reducirt. Oder zu kleiner Kopf, zu grosser Mund, übergrosse Hände und Füsse u. dgl.

2. *Asymmetrien* an *Schädel* und *Gesicht*, z. B. die eine Hälfte des Schädels oder des Gesichts ist kleiner, als die andere u. dgl.

3. *Misgestaltungen einzelner Körpertheile für sich*, z. B. *fliehende Stirn*, d. h. wo die Stirn von der Nasenwurzel ab nach hinten oben zurückweicht, keine richtige Wölbung und Masse hat.

Ferner: *abgeplattetes Hinterhaupt, zu hoch gesprengter* oder zu *flacher harter Gaumen, Unregelmässigkeiten der Zahnreihen, unvollständige und misstaltete Ohren, monströse Ohrmuscheln, mangelhafte* oder *gegen die Wangen angewachsene Ohrläppchen, wulstige Lippen*, namentlich *wulstige Unterlippe, Schielen, ungleiche Färbung der Iris, Klumpfuss* u. A.

B. *Durch Degenerationszeichen im weiteren Sinne;* als solche sind aufzufassen allerlei mehr oder weniger andauernde *funktionelle Anomalien.* Sie treten bei Psychopathisch Minderwertigen zum Theil *schon sehr früh hervor.* Dazu gehören z. B. namentlich:

Sensible Störungen, wie Kopfdruck und neuralgische Beschwerden;

Motorische Störungen, wie Muskelzucken, namentlich im Gesicht; oder Muskelzittern; *gesteigerte Erregbarkeit des Herzens;* und

Vasomotorische Störungen, die sich in Anfällen von *Herzklopfen, Pulsfrequenz*, Geneigtheit zum *Erröthen* aussprechen.

Stärkere Anomalien sind:

Neigung zum *Zusammenschrecken*, zum *Schwindel*, zu *Ohnmachten*, zu *Convulsionen* u. A.

VI. Die psychopathisch minderwertigen *Kinder* und *jungen Leute* werden gewöhnlich als *nervös*, als *psychisch belastet*, als *eigenartig* (phantastisch, extravagant, leutescheu u. s. w.), als *zurückgeblieben, schwach begabt, schwer* zu *unterrichtend*, als *sittlich verkommen* u. dgl. bezeichnet.—Es soll aber kein Individuum als *psychopathisch minderwertig* bezeichnet werden, bei dem die psychischen Regelwidrigkeiten nicht *pathologisch* (im medicinischen Sinne) sind.

VII. Wo bei den Erhebungen jeweils auch noch zwischen psychopathischer *Disposition*, psychopathischer *Belastung* und psychopathischer *Degeneration* unterschieden werden kann, ist es sehr erwünscht, wenn solches geschieht.—Die *Ursachen* der *erworbenen* psychopathischen Minderwertigkeiten sind am häufigsten geistige und gemüthliche Ueberanstrengungen verschiedener Art und körperliche Krankheiten, namentlich Krankheiten der Hirnhäute und des Hirns (Meningitiden, Epilepsie u. s. w.).—Besteht ein Zweifel darüber, ob ein Individuum an einer angeborenen oder einer erworbenen Psychopathie leidet, so wird es zu den angeborenen Psychopathischen gerechnet, aber ein Fragezeichen beigefügt.

VIII. Bei der unmittelbar auf die Heredität Bezug habenden Abtheilung des Zählblättchens wird gewünscht, dass jedes Fach einzeln ausgefüllt und ein verneinendes Ergebniss ebenso ausdrücklich konstatirt werde, wie ein bejahendes; mit anderen Worten, dass in jedem einzelnen Fache, wenn das betreffende Verhalten zweifellos ist, ein Ja oder ein Nein eingetragen werde. Enthält eines der Fächer weder Ja noch Nein, so ist das Fach *nicht* offen zu lassen, sondern mit einem Fragezeichen auszufüllen.

IX. Unter *Geisteskrankheit* ist sowohl *Irrsinn*, als auch *Idiotie* verstanden. Wenn nach dem Bestehen (oder Bestandenhaben) von psychopathischer Minderwertigkeit in der Ascendenz und bei den Geschwistern der zu Zählenden gefragt ist, so kommen da, was die *Erwachsenen* unter diesen Verwandten betrifft, (nach Koch) Zustände in Betracht nach deren hervorstechenden psychischen Merkmalen man die Betreffenden je nachdem als *zartbesaitete* Seelen, *weinerliche Gemüthsmenschen*, *Träumer* und *Phantasten*, *Menschenscheue*, *Mühselige*, *Gewissensmenschen*, *Empfindliche* und *Uebelnehmerische*, *Launenhafte*, *Exaltirte* und *Exzentrische*, *Gerechtigkeitsmenschen*, *Stadt-* und *Weltverbesserer*, *Eigensinnige* und *Rechthaberische*, *Hochmüthige*, *Taktlose*, *Spöttische*, *Eitle* und *Gecken*, *Bummler* und *Neuigkeitskrämer*, *Unruhige*, *Bösewichte*, *Schwachköpfe*, *Sonderlinge*, *Sammler* und *Erfinder*, *missratene* und *nicht missratene Genies* u. s. w. bezeichnen kann.—Aber alles dieses sind die Betreffenden auf der Grundlage *organisch-pathologischer* Schädigung.

Trunksucht, *Neigung zu Selbstmord* und *zu Verbrechen* deutet sehr häufig auf das Bestehen von *psychopathischer Minderwertigkeit* (oder auch von Geisteskrankheit) bei den Betreffenden hin. Doch wird aus mehreren Gründen nach diesen Dingen noch besonders gefragt.

X. Von somatischen Nervenkrankheiten kommen in Betracht *Epilepsien*, welche nicht oder noch nicht zu psychopathischer Minderwertigkeit (oder zu Geisteskrankheit) geführt haben, Zustände mit *häufigen Kopfschmerzen*, mit *Schwindel-* und

Ohnmachtsanfällen, habituelle Migräne, habituelle Neuralgien und dergleichen. *Hypochondrie* und *Hysterie* werden als psychopathische Minderwertigkeit (beziehungsweise als Geisteskrankheit) berücksichtigt.

Auf Bemerkungen darüber, ob die Momente, welche hereditäre Belastung herbeizuführen geeignet sind, jeweils schon *vor* der Geburt des betreffenden Individuums in seiner Ascendenz vorhanden waren, wird vorerst verzichtet.

XI. Bei Frage 9 ist die Schädellänge mit Tastenzirkel von der Stirnglatze (glabella) bis zu dem am weitesten davon stehenden Punkt am Hinterhaupt in der Medianebene des Schädels zu messen. Als Schädelbreite ist die grösste Querbreite aufzusuchen.

XII. Bei Frage 24 "wo untergebracht" bezeichne man die Lehr- oder Heil- oder Versorgungsanstalt genau nach ihrem Wesen, z. B. Anstalt für Schwachsinnige und Idioten, Schule für Schwachbegabte, Anstalt für Zurückgebliebene, Besserungsanstalt, Anstalt für Nervenkranke, Anstalt für Epileptische oder wie immer die betreffende Anstalt selbst sich bezeichnet. —Bei den in Lehranstalten anderer Orte und den in Specialanstalten untergebrachten Individuen oder bei Kindern, die im Elternhaus leben, ohne eine Lehranstalt zu besuchen, wird die Frage nach der Lehranstalt im Eingang des Zählblättchens offen geiassen.

XIII. Es empfiehlt sich, wenn auf einem Zählblättchen falsch eingetragen wurde und nicht ganz unzweifelhaft deutlich korrigiert werden kann, dasselbe zu zerreissen und ein neues auszufüllen.

Entwurf eines Erhebungsformulars für Untersuchung über psychopathische Minderwertigkeit der Kinder.

1. Land Kreis Gemeinde .
2. Lehranstalt Laufende No. (für diese Lehranstalt).
   (Bei No. 1 der betr. Anstalt ist anzugeben Gesammtzahl der Schüler darunter Kn. Md. .)
3. Des Untersuchten Geschlecht: männlich weiblich .
4. Alter Jahre Monate (geboren am 18).
5. Geburtsland Kreis Ort .
6. Religion: evangelisch, katholisch, israelitisch, andersgläubig.
7. Grösse (ohne Fussbekleidung) Centimeter. Gewicht (unter Abrechnung der Kleidung) Kil. Gr.
8. Ernährungszustand.
9. Schädellänge Schädelbreite ob Schädel unnormal.
10. Farbe der Augen.
11. Farbe der Haare.
12. Farbe der Haut.

Befund der Untersuchung (ob normal, oder welche Anomalien).

13. Der Augen (bezw. des Gesichts).
14. Der Nase (bezw. des Geruches).
15. Des Mundes und Rachens.
16. Der Ohren (bezw. des Gehörs).
17. Liegt vor Epilepsie, Veitstanz, allgemeine körperliche Schwäche, oder ein anderes körperliches Leiden u. welches?
18. Finden sich somatische (anatomische-functionelle) Degenerationszeichen u. welche?
19. Andere Symptome für die Vermuthung der Minderwertigkeit. Wird demnach vermuthet?
20. *Angeborene* psychopathische Minderwertigkeit? (Disposition.—Belastung.—Degeneration.)
21. *Erworbene* psychopathische Minderwertigkeit? (Disposition.—Belastung.—Degeneration.)
22. Zeit des Beginnes des (erworbenen) Leidens?
23. Lebt das Kind im Elternhause (in der Familie)?
24. Oder ist es in einer Anstalt untergebracht u. in welcher?
25. Besucht das Kind eine Schule u. welche? (Ort, Name u. Art) u. welche Klasse?
26. Urtheil des Lehrers über des Kindes Fähigkeiten, Kenntnisse, Fortschritte u. Betragen?
27. Ehelich oder unehelich geboren.
28. Zahl der Geschwister, einschl. der Verstorbenen .

—	Es finden oder fanden sich bei des untersuchten Individuums						
		des Vater's			der Mutter		
	Vater.	Vater.	Mutter.	Mutter.	Vater.	Mutter.	Geschwister.
29. Beruf u. Stand - - -							
30. Wohlstandsgrad - - -							
31. Grad der Blutsverwandtschaft -							
32. Geisteskrankheit - - - -							
33. Psychopathische Minderwertigkeit							
34. Somatische Nervenkrankheit -							
35. Trunksucht - - - - -							
36. Selbstmord od. Selbstmordversuch							
37. Hang zu Vergehen od. Verbrechen							
38. Allgemeine Schwächlichkeit .							

39. Bemerkungen:

Ort u. Datum der Erhebung.

Unterschrift des Beobachters.

Kinder mit abnormer Kopfbildung.

VON

Prof. EDUARD RITTER VON HOFMANN, Wien.

Zu den *Kindern*, welche in Schule und Haus ihrer abnormen Körperbeschaffenheit wegen einer grösseren Beachtung und Schonung bedürfen, gehören auch die *mit abnormer Kopfbildung*, und zwar nicht bloss die Kinder mit hydrocephalischem, sondern auch die mit rachitischem und durch vorzeitige Nahtverwachsung verbildetem Schädel.

Ihrer Natur nach kommen solche Schädelbildungen gerade im Kindesalter relativ am häufigsten vor, finden sich daher auch bei Schulkindern nicht ungewöhnlich, was ziffermässig zu konstatiren wohl der Mühe werth wäre.

Solche Schädel sind ein auch für Laien erkennbares Merkmal einer abnormen oder gehemmten Hirnentwicklung und einer dadurch bedingten geringeren Leistungsfähigkeit und grösseren Labilität des Gehirns.

Die geringe psychische Leistungsfähigkeit hydrocephalischer Kinder ist bekannt, weniger aber die Thatsache, dass eine solche auch bei rachitischen und durch vorzeitige Synostose verbildeten Schädeln bestehen kann und häufig besteht. Es fehlen zwar in dieser Richtung systematische Untersuchungen; es lässt sich aber *a priori* aus der Natur der Abnormität erwarten, dass ebenso wie der ihm analoge Kretinismus auch der Rachitismus, noch mehr aber die vorzeitige Verwachsung der Schädelnähte, desto mehr die Leistungsfähigkeit des Gehirns herabsetzen müssen, je intensiver sich die durch die Knochenerkrankung gesetzte Wachsthumshemmung des Gehirns gestaltet.

Schon wegen dieser geistigen Insufficienz, welche mit solchen Deformitäten in den höheren Graden regelmässig verbunden ist, aber auch in den minder hohen verbunden sein kann, verdienen dieselben eine pädagogische Beachtung und gehören jedenfalls mit zu den Factoren, welche vom Lehrer, Schulaufseher und insbesondere vom Schularzte bei der Beurtheilung der Leistungsfähigkeit und der ganzen geistigen Persönlichkeit des einzelnen Kindes mit herangezogen werden müssen.

Eine noch höhere Bedeutung gewinnen solche Deformitäten durch die grössere psychische und physische Labilität des Gehirns, welche sie bedingen.

In psychischer Beziehung findet sich erhöhte Reizbarkeit, Geneigtheit zu pathologischen Verstimmungen, besonders in der Pubertätsperiode, sowie erhöhte Reaction gegen Affecte, insbesondere gegen Schreck. Auch eine grössere Inclination zu Geistesstörungen kann bestehen. Wird ja von vielen Psychiatern namentlich die Asymmetrie des Schädels einestheils als Zeichen hereditärer Degeneration, anderseits als ein zu Geistesstörungen prädisponirendes Moment angesehen. Auch dürfte es wohl kaum auf einem blossen Zufall beruhen, dass bei den von mir secirten jugendlichen Selbstmördern verhältnissmässig häufig Schädeldeformitäten der genannten Art gefunden wurden.

In somatischer Beziehung äussert sich die Labilität des Gehirns solcher Kinder durch Geneigtheit zu Convulsionen, Neurasthenie und Neurosen verschiedener Art, aber auch durch gesteigerte Empfindlichkeit gegen fieberhafte Zustände und gegen Traumen.

Schon ein leichtes catarrhalisches Fieber, das bekanntlich bei kleinen Kindern so häufig vorkommt, kann cerebrale Erscheinungen veranlassen, noch mehr aber Erkrankungen, welche, wie z. B. die Pneumonie oder die acuten Exantheme, in ihrem Beginne mit hohem Fieber einhergehen.

Ich habe wiederholt Kinder obducirt, welche unter meningitischen Erscheinungen acut erkrankt und rasch gestorben waren, während bei der Obduction keine Spur von Meningitis, sondern eine frische, in ihrer Ausdehnung mitunter geringe, Pneumonie oder ein acutes Exanthem im Ausbruchstadium gefunden wurde. In allen diesen Fällen fand sich aber eine rachitische oder synostotische Schädelstenose oder Hydrocephalus, welche offenbar der Grund waren, warum das Gehirn auf das durch eine andere Erkrankung bedingte Fieber so unverhältnissmässig reagirte, dass dadurch eine Meningitis vorgetäuscht wurde.

Mehrmals handelte es sich dabei um Fälle, in denen, weil der Erkrankung angeblich Züchtigungen in der Schule oder ähnliche Einwirkungen vorangegangen waren, an eine traumatische Meningitis gedacht und die gerichtliche Obduction eingeleitet worden war.*

Auch habe ich eine ansehnliche Zahl von Kindern obducirt, die unmittelbar nach unbedeutenden Gewalteinwirkungen auf den Kopf, z. B. Ohrfeigen, Ziehen bei den Haaren, von Hirnerscheinungen befallen wurden und kurz darnach gestorben sind, und wo sich bei der Obduction in der Regel herausstellte, dass die betreffende Gewalt nicht ihrer allgemeinen Natur nach, sondern nur wegen des Bestehens eines der erwähnten pathologischen Verhältnisse, somit, wie sich das österreichische Gesetz ausdrückt, wegen einer "eigenthümlichen Leibesbeschaffenheit" einen so schlimmen Ausgang genommen hatte.

Am begreiflichsten ist ein solches Vorkommniss beim Hydrocephalus da; besonders, wenn man die ganz plausiblen von *Duret*, *Gussenbauer* u. A. über das Wesen des als "Commotio cerebri" bezeichneten Symptomenkomplexes aufgestellten Theorien sich vor Augen hält, durch eine den Kopf erschütternde Gewalt desto leichter eine traumatische Reizung der Wandungen der Hirnkammern, namentlich der vierten wird zu Stande kommen können, je grösser die Flüssigkeitsmenge war, welche gerade in den Ventrikeln sich befand.

Aber auch bei rachitischer Schädelbildung, die sich überdies häufig mit Hydrocephalus verbindet, sowie bei vorzeitiger Nahtverwachsung sind derartige abnorme Reactionen wohl verständlich, da der Raumbeengung wegen Erschütterungen des Kopfes leichter auf das Gehirn sich fortpflanzen, und als solche sowohl als durch reactive Hyperämie

* Prof. Hofmann demonstrirt einen solchen Fall, respective das Schädeldach eines Knaben von 9 Jahren mit Verwachsung der Satura sagitalis und der linken Hälfte der Satura coronaria. Pneumonie.

ungleich leichter zu functionellen Störungen führen können als bei normalem Schädel respective Gehirn.*

Es sind demnach recht wichtige Eigenthümlichkeiten, welche Kindern mit abnormen Schädelbildungen zukommen, und ich glaube, dass Lehrer und jene, denen die Aufsicht in der Schule zusteht, auf diese Kinder besonders aufmerksam gemacht und ihnen eine besondere Beachtung und Schonung derselben empfohlen werden soll.

Es liegt dies sowohl im Interesse der betreffenden Kinder als der Lehrer selbst, da letztere durch Beachtung der erwähnten Verhältnisse sich am besten vor der unter allen Umständen höchst peinlichen Anklage schützen können, dass sie durch das Maass der erlaubten überschreitende Züchtigungen oder sonstige unzulässige Behandlung eine schwere Erkrankung oder gar den Tod des Schulkindes veranlasst hätten.

DISCUSSION.

Dr. Escherich (Graz) erinnert an die Beobachtung Soltmann's, wonach geistig abnorm veranlagte Kinder mit der linken Hand Spiegelschrift schreiben. Es würde dies ein sehr einfaches Mittel sein zur Erkennung abnormer geistiger Veranlagung. Nach untersuchungen, die durch meinen Assistenten Dr. Cahen in Graz gemacht wurden, ergaben, dass die Angabe Soltmann's richtig ist, dass aber auch zahlreiche als gesund zu bezeichnende Kinder in Spiegelschrift schreiben und zwar um so mehr je häufiger je jünger sie sind, Mädchen häufiger als Knaben. Mit zunehmendem Alter vermindert sich der Prozentsatz derselben rasch.

Prof. Guye (Amsterdam) said I have listened with great interest to the very able paper read by Dr. Warner in the first meeting of this Section, and to the remarks offered in the discussion by Dr. Shuttleworth, Dr. Fletcher Beach, Dr. Langdon Down, and others. I take the liberty to offer a few remarks on a question which is related to that about the care to be taken of the various classes of feeble-minded and imbecile children, and which are, in my opinion, doubly important if the work expressed by Dr. Warner and assented to by this whole Section, comes to be fulfilled, that is, that the State should take care that all feeble-minded children shall be provided for in special classes. It is not quite a new question to which I wish to draw the attention of the section. For a number of years various authors, besides myself, Rupprecht, Michel, Seiler, Hack, Elsberg, Schäffer, Ziem, Bresgen, and others engaged in the study and treatment of diseases of the nose, have published cases where disturbance in the cerebral functions were prominent. In 1887 I proposed the name of *aprosexia* for one of the principal symptoms of this disturbance, that is the inability to fix the attention on any more or less abstract subject. With the impairment of the attention goes feebleness

* Prof. Hofmann demonstrirt das Schädeldach eines 8jährigen Mädchen mit vollständiger Verwachsung der Pfeil- und Kranznaht. Der Tod war einige Stunden nach einem leichten Schlag mit der Hand auf den Kopf erfolgt, ohne dass sich weitere anatomische Veränderungen fanden.

of memory and tendency to headache. In some cases the organs of sight and hearing are affected consecutively, conjunctivis and hardness of hearing being the results. I will not now go into any details. I have done so in a paper read at the meeting of the British Medical Association in Leeds in 1889.* I have been very glad to see that not only has the name aprosexia been very generally adopted, but that my views have been confirmed by various authors belonging to different countries. Thus, in England, Dr. Hingston Fox† has published a paper On Nasal Catarrh and Aprosexia. Dr. William Hill‡ has found in the Earlswood Asylum for Idiots that nearly all children are mouth-breathers, night-snorers and the victims of nasal or pharyngeal obstruction. They are all aprosexic. In Germany Dr. Max Bresgen has sent an address to the Minister of Instruction, requesting that a regular medical supervision should take place in schools, especially with regard to the state of the upper respiratory organs of the school-children. I must add that he had done this before my first publications on the subject, in 1884, and that he sent a second address in 1887, in which he made use of my publication on aprosexia as an argument giving new strength to his previously expressed views and wishes. Dr. Kafemann§ of Danzig has published the result of his examination of 2,238 school-children between 6 and 14 years of age. He found nasal stenosis and insufficient nasal respiration is about one-tenth of the children, producing aprosexia in a great number of cases. In France Dr. Raulin|| in a paper published in 1890 has expressed similar views, and has laid great stress on the necessity of regular medical inspection, not only of the schools, but also of the school-children especially with respect to the state of their nasal respiration. So we see that medical opinion, as far as it is expressed, is by way of agreeing about the principal sides of the question; but I am not aware that the men who have influence on the hygienic organisation and supervision of schools, and the teachers themselves generally, are sufficiently impressed with the importance of the question.

Will you allow me to give you two examples from my own practice of the last year, which will illustrate that importance. 1. I have seen a case nearly identical with the first case which drew my attention to the subject, and which I published some time ago. A child of parents in a very fair social status, aged about 7 years, was brought to me last year with enlarged tonsils, complete mouth-breathing and a decidedly stupid-looking face. The hearing was nearly normal, nevertheless the child, who had been to school a whole year, had not been able to learn more than the three first letters of the alphabet. I removed the tonsils and ordered an appropriate treatment against the nasal stenosis. A few weeks after the beginning of the treatment the child knew all the letters of the alphabet; he is getting on at school now like other children, which it is clear he could not have done in his former state, when he was not able to learn or recollect the letters of the alphabet. He would in that state have been declared a mentally feeble or even an imbecile child by any competent person not acquainted with the symptoms of aprosexia.

* Brit. Med. Journal, Sept. 28th, 1889, and Journal of Laryngology, 1889, 12.

† Lancet, May 12th 1888.

‡ Brit. Med. Journ. Sept. 28th 1889.

§ Schuluntersuchungen mit Bezug auf Aprosexia, &c. Danzig, 1890.

|| Rev. de Laryngol, 1890, No. 22.

2. The second case which I wish to record is that of a girl of 15 years, brought to me by her father on the 8th of April last. She had complained of habitual, nearly daily, headache for the last two years, had great difficulty in getting on at school, the lessons which she learned in the evening she had forgotten next morning. She had been a mouth-breather from her earliest infancy, which we can infer from the fact that she has had great difficulty in suckling, on account of her nasal respiration being deficient even at that age. The hearing was nearly normal; she could hear whispered words at 8 M. with the right and at 9 M. with the left ear. I removed part of the pharyngeal tonsil and directed the treatment against the nasal stenosis. One week after that, when she came to see me again, I was astonished at her bright looks; she had had no headache at all, and on my questioning her about the state of things at school, I heard that the teacher that same morning had given her a "5" for history. I asked what figure she had obtained formerly, 5 being the highest figure. The answer was that she had generally had a 0 throughout the whole year, only now and then a 1. On the 8th of May, when I saw her for the last time, she told me that she now learned her lessons very easily in the morning before school-time; and in every respect she could be considered as a normal child.

These two cases may stand as examples of an only too numerous class of children suffering from nasal aprosexia, and giving the impression of feeble-minded children, which they are not, and need not be, if adequately treated.

Finally, I wish to endorse the conclusions of Dr. Raulin of Marseilles, as expressed in the paper already alluded to.

1. No child should be taken into a school without a medical certificate showing it to be bodily fit for the mental exertion of intellectual training. 2. There ought to be medical school-inspectors, to whose task among others should belong the careful inspection of the upper air-passages of the school children. 3. Teachers ought to refer to the medical inspectors all children who lag behind in intellectual development, and who breathe through the mouth.

And I, for myself should like to add to these one more conclusion :— 4. As long as medical school-inspectors are wanting, teachers should be impressed with the importance of giving attention to the question of mouth-breathing, especially in children who are backward in intellectual development, and with their duty of warning the parents or guardians of such children to seek competent medical advice.

Dr. William Hill, (London), considered that Prof. Guye had filled in an important hiatus in this discussion. Backwardness and stupidity had been actively investigated from the medical and psychological point of view, but educationalists and physicians had neglected the surgical aspect of the question. He was able from personal observation to corroborate Prof. Guye's conclusions. Dr. Langdon Down had rightly remarked on the importance of an euphonious nomenclature in connexion with the delicate subject of backwardness, stupidity, and feeble-mindedness. The term "aprosexia" coined by Prof. Guye supplied a long-felt want, although its originator must not flatter himself that it had yet been generally adopted. It had been rightly pointed out that aprosexia or inability to prosecute a line of thought or work for long together was largely a symptom of nasal and pharyngeal obstructions. Operations for the relief of enlarged tonsils, adenoid growths in the nasopharynx and polypus often produced the most gratifying results in backward children.

He had been surprised that Dr. Warner in his otherwise admirable investigations had not been struck with the evil results of obstructions to nasal respiration, and that his writings contained no reference to the subject. Dr. Hill's own far more limited observations in hospital and private practice led him to regard the hygiene of the nose and throat as of the highest importance to teachers and pupils.

Dr. Kotelmann moved the following *Resolution*:—

"That this Congress do appoint a commission consisting of three persons severally conversant with mental diseases, education, and statistics, whose duty it shall be to inquire into mental feebleness in children, beginning in small districts, and to continue and carry out the same according to a fixed plan. The Congress shall empower the commissioners to add to their number, and to appeal to recognised authorities for assistance if necessary."

Mr. J. P. Richards seconded the resolution.

Dr. Warner moved, and Dr. Fletcher Beach seconded, the following *Amendment*:—

"That this Congress do appoint a commission consisting of persons severally conversant in—1. The examination of the physical condition of children. 2. Mental conditions and diseases. 3. Education and methods of dealing with children. 4. Statistical compilation of facts—whose duty it shall be to inquire into the condition of children in schools and elsewhere, and to carry out the same upon a fixed plan. This Congress empowers the commission to add to their number, and appeal to recognised authorities and sources for assistance if necessary."

The Amendment was *carried*.

The Education of the Blind.

BY

F. J. Campbell, LL.D., Principal of the Royal Normal College for the Blind.

The scope of my paper prohibits even a brief account of the pioneers who have laboured in the cause of the blind, or a historical statement of the rise and progress of educational movements in different countries. My object is to show the present condition of the blind, particularly in this country, and briefly to indicate what should be done for the young blind in order to make them self-supporting.

I am unable to give detailed statistics from the Census returns of 1891, but for our purpose, the accumulated information derived from the Census returns between 1851 and 1881 will be sufficient. The proportion of the blind to the whole population has decreased since 1851, in which year a special account of the blind was first taken, but the decrease noted in the Census of 1881 was greater than in the previous decades. In 1881, the total number of blind in the United

Kingdom was 32,296. In England there was one blind person in every 1,138; in Scotland one in every 1,182; in Ireland one in every 847. In most countries there are more males than females who are blind. Ireland, Scandinavia, and Finland are striking exceptions; in Ireland there are 1,141 male blind per million males in population, and 1,219 female blind per million females in population; in Norway 1,313 males, 1,411 females, per million; in Finland 1,514 males, 2,938 females, per million. Speaking generally of countries in temperate regions of the globe, there are about one thousand blind persons to each million of the population. In 1881, in England and Wales, there were 1,710 blind children between the ages of 5 and 15. As the popular conception of the term "blindness" is total blindness, many with defective sight are not included in the Census returns. For educational purposes and practical business training, those who cannot be taught as seeing children must be included with the blind given in the Census, and will probably double the number requiring special training.

The large majority of the blind are found among the poor, and the cost of their education must either be drawn from charitable sources, or provided by the State. Continental Governments, the United States, and most of the English Colonies make provision for the education and training of their blind children. They endeavour by increased appropriations to place them as nearly as possible on an equal footing with the seeing. In Great Britain this work has been left mainly to charity; within a few years several School Boards* have taken up the elementary education of blind children, and in 1890 an Act was passed for the elementary education of blind children in Scotland, which, though wholly inadequate, is a move in the right direction. The generous efforts that have been made to alleviate the condition of the blind in this country have aimed, too often, at temporary relief and comfort, rather than practical measures for helping the blind to help themselves. Benevolent ladies and gentlemen in all parts of the country have devoted time and money to the cause, but a large majority of the blind, not only those who lost their sight in after-life, but those who have been blind from childhood, are still to be found among the helpless classes. When I came to London in 1871, I found, out of the 3,150 blind in London, 2,261 were dependent on charitable relief.

The Royal Commission, after four years of indefatigable labour, published its Report in 1889. Their extensive inquiry, to ascertain what proportion of the blind followed the trade taught them in institutions, furnished the following result: "Out of 1,267 blind men who "had learnt trades in various institutions in the United Kingdom only "734, or 58 per cent. proved, according to their own account, to be "following the trade learnt at those institutions. Of these 1,267 men, "about 15 per cent. were earning under 5*s*. per week, about 25 per "cent. were earning between 5*s*. and 10*s*. per week, and about 11 per "cent. were earning above 15*s*. per week. But the 42 per cent. who

* The movement originated in Glasgow.

" had found themselves compelled to seek other means of livelihood, " were earning far smaller wages in the aggregate than the 58 per cent. " who were still following the trades taught them at the institutions.

" Assuming that these statistics hold true of the blind at large, it " must be admitted that the fact that 42 per cent. of those trained in " institutions find themselves unable to continue to practice the trade " taught to them, while about 34 per cent. of the remainder do work, " but earn less than 5*s*. per week, indicates either a great deal of " indifferent teaching, or a want of proper facilities for working and " disposing of their work. Continuing this inquiry, the Commission " issued letters to a large number of blind persons throughout the " United Kingdom, to which they received 5,848 replies. Of the total " number no less than 4,605 declare their inability to maintain them- " selves without charitable assistance, while only 959 state that they can " so maintain themselves; 3,282 state that they earn nothing at all."

The Commission, quoting from Dr. Armitage, states: "In 1866 " it was found that the blind visited in connexion with the Indigent " Blind Visiting Society, whether trained in institutions or untrained, " had scarcely anything to do; that they were to a very great extent " idle mendicants, or depending on charitable relief in some form, " either from the guardians or from private societies or individuals. " In the case of musicians only one in 200, or ½ per cent. of all the " pupils trained in institutions, seemed to be able to support themselves, " while in Paris the education of the blind as musicians was infinitely " superior to anything that we then had in England, and 30 per cent. " were able fully to support themselves by the profession of music." In Boston, U.S.A., a much higher per-centage of success was obtained by professional musicians.* This sad state of things is due, in part, to the failure to recognise that the blind must have an education and training equal to those of the seeing who follow the same avocations. Much time and effort are lost for want of systematic action; there is no uniform plan of training. Good and earnest people work with indefatigable zeal upon methods which have proved worthless. The benevolent enter upon the work for the blind because their sympathies have been excited by the calamity of blindness; but they are not prepared to apply the same practical business rules of life to a number of blind children that they would to the same number of seeing children. Of course, they wish to prepare them for self-maintenance, but the prevailing idea is to make them happy and comfortable for the moment. The young blind, and even a majority of those in early manhood, can be made active and useful members of the community by suitable training; and it is clearly the duty of society to give the blind such educational privileges and business training as will enable them to earn their own support. Without any regard to humanitarian considerations, it is cheaper to educate than to pauperise.

* To improve the musical education of the blind in this country, the Royal Normal College and Academy of Music was established at Norwood in 1872. Of the pupils who have been trained in music, between 80 and 90 per cent. are self-supporting, and many of them earn handsome incomes.

In the public mind, blindness has been so long and closely associated with dependence and pauperism, that schools for the blind, even the most progressive, have been regarded hitherto as asylums rather than educational establishments. The fact of being classed among dependents and considered subjects of special charity is not only a mortification but a serious disadvantage; it leads to the workhouse. A sad mistake in the training of the blind is the lack of an earnest effort to improve their social condition. Whenever pupils in institutions are treated, and habitually spoken of, as poor, indigent, blind children, a feeling of semi-pauperism is fostered, and when the blind leave such institutions they become paupers in reality. In most countries free education has been provided for seeing children, but when instruction is given to the blind, it is still considered a charity. In the United States free education is regarded as the corner-stone of the Republic; the public school system provides a good education alike for the rich and poor, the seeing and the blind. But even in America the schools for the seeing are placed under the management of State Boards of Education, while corresponding schools for the blind, in common with asylums for the imbecile and insane, with workhouses and reformatories, are placed under Boards of State Charities. I rejoice that a more enlightened public opinion is working an important change, and already a few of the States have transferred the management of the schools for the blind from the Board of Charities to the Board of Education.

A practical system of education which has for its object to make the blind independent and self-sustaining must be based upon a comprehensive course of physical development. As a class the blind have much less vitality than the seeing, and this lack of physical power leads to indolence, timidity, and discouragement. The blind must be roused from their willingness to depend upon others, and made to believe in the possibility of independence and success. It is the lack of energy and invincible determination, not the want of sight, that has caused so many failures among the blind. In my long experience with the blind, both of Great Britain and America, I have found nothing that will rouse the indolent, and encourage the timid, but physical training. Some of the most successful pupils that ever left the Royal Normal College came to us idle and indolent boys and girls without any fixed purpose; the struggle was long and sharp, but they are to-day living examples of the principles we are advocating.

A blind man who has received mechanical training, general education, or even musical instruction, without physical development, is like an engine provided with everything necessary, except motive power. Even a well-ordered gymnasium and enthusiastic teachers are not sufficient; ample playgrounds, skilfully arranged and adapted to the requirements of the blind are essential—swimming, rowing, skating, and cycling should be included. Our daily gymnastic classes are as regular as our school or music classes; but class training, though absolutely essential, will never develop that spontaneous love of play observable among seeing boys and girls. Each of the five schools into which the college is divided has a separate playground with specially

adapted walks, rocking boats, rob-roys, tilts, swings, &c., so arranged as to be distinct and yet form a harmonious whole.

Under normal conditions it is desirable that young children should remain under home influences; blind children form an exception to this rule in a large majority of cases. Parents find it easier to attend to their wants and requirements than to teach them how to do for themselves. Blind children are indulged and over-praised; they are told that all they do is wonderful, and yet many of these prodigies can neither feed nor dress themselves. Through the want of active employment, either of work or play, they become idle and helpless. Poverty is a hard taskmaster; the over-worked mother is grateful if the blind child will sit still in a corner and thus keep out of danger. As they are not taught to work, they do not learn to appreciate the value of time, and in after-years this is one of the most difficult lessons to inculcate. Having drifted through childhood, they are content to drift through life.

In the future educational system for the blind, we hope to see children of from four or five to seven years of age carefully and systematically trained in kindergarten, modelling, and calisthenics, with elementary instruction in reading, writing, and numbers. The important habits of punctuality, regularity, and precision should be cultivated. A lesson, however short and easy, should be recognised and respected as a lesson. Thus the principle of work will be established, and the plays and games become all the more enjoyable. Between seven and ten years of age, the child of average ability, who has had the previous kindergarten training, ought to accomplish all the work of the first three standards of the Code. It should then be transferred to a good special preparatory school, similar to the preparatory school of the Royal Normal College. The course should include reading, writing, arithmetic, geography, English grammar and composition, English history, and object lessons, with thorough and systematic instruction on the pianoforte, in harmony, and singing. There should be a technical shop supplied with work-benches, sets of tools, and suitable materials. Technical training, or the proper use of tools, should form an important part in the early education of blind children. All the children should have a thorough course in Anglo-American Slöjd, which they should pursue step by step as methodically as their school studies. This course awakens the perceptive faculties, gives activity to the body, and prepares the hands and fingers for pianoforte playing, pianoforte tuning, or handicraft. If the blind child has no gifts for literary and musical studies, or pianoforte tuning, if he has early technical training, he will make a more skilful mechanic and a more successful bread winner. Blind children should be taught to run, play, and enjoy themselves in games and sports like seeing children. In the Normal College the young children are taught roller-skating, rowing, swimming, military drill, free gymnastics, especially Ling's, the use of Sargeant's developing apparatus, &c. They also have lessons in deportment, the object of which is to remove their stiffness and awkwardness, to cultivate graceful movements, and to make them as much as possible like seeing persons.

The aim of the teachers is to inspire a love of learning, to form correct habits of study, and to cultivate a taste for reading, which shall lead the pupils in after years to make good use of the valuable and ever-increasing library of embossed books. Above all, inspire them with a belief that God has placed them in the world to do good and useful work, and that He will require an account of the talents entrusted to them, be they few or many.

After a three or four years' course in the preparatory school, an intelligent opinion can be formed in regard to the future career of the pupils. They will fall naturally into the following categories:—*a.* A certain number will succeed better in handicraft than in any other calling, and should be drafted into a suitable mechanical school. *b.* A few will have special gifts for general business, and should be educated accordingly. *c.* A few will have the ability and ambition to prepare for the university, and the special college should afford them the most thorough preparation for the University examinations. *d.* Some will have the necessary talent, combined with the requisite character and industry to succeed in the musical profession; in addition to a liberal education, these should have musical instruction fully equal to that given to the seeing, in the best schools of music. *e.* Some may achieve excellent success as pianoforte tuners, and in the pianoforte tuning school strict business habits should be cultivated, and the same attention to work required as is demanded of seeing workmen in well-regulated pianoforte factories.

Wherever these pupils are sent, their future success will depend not no much upon *what* they are taught as *how* they are taught. Educators of the blind must recognise not only the want of one of the five senses, but all the physical defects and mental peculiarities which naturally arise from blindness. Until these fundamental difficulties have been met and overcome, it will be impossible to give the special training necessary to prepare the blind for useful and active independence.

Although it is impossible to deal fully with handicrafts and professions, I must say a word in regard to music. Music, when properly taught, is the most remunerative profession for the blind, and yet in all countries many who have tried to earn a livelihood by music have failed. Their failure is due to the following reasons:—1. In the selection of pupils for the profession, the musical ear rather than the mental capacity was considered. 2. The physical and intellectual powers of the musical students were not developed. 3. The musical instruction and practice was insufficient both in quantity and quality. 4. The opportunity of hearing music in its highest forms was not afforded them. 5. They were not trained in the art of teaching, especially in the best method of giving instruction to seeing children. To become successful in the profession, it is necessary for the blind to have opportunities of instruction, practice, study, and hearing music equal to the seeing, with whom they will have to compete in the open market. A National College of Music for the Blind, in any country, should afford the pupils opportunities fully equal to those enjoyed by the seeing in the best conservatories of music in that country. In all branches

of the art the services of the very best professors should be secured. If the blind musician is to rise above mediocrity, systematic musical instruction in childhood is indispensable, and good instruction will avail very little unless the practice is under constant and judicious supervision. The pupils should constantly hear the best performances of high class music. The Royal Normal College was located in Norwood that its pupils might profit by the great musical advantages presented in the varied programmes of high class music performed in the Crystal Palace. In the rehearsals and concerts the students have opportunities for becoming familiar with the standard works of all the great masters, and of hearing performances by distinguished artists from all parts of the world.

Institutions for the blind, even if their means are limited, ought to have at least good *elementary* musical instruction. In the first instance this may not produce so much effect on the public as choruses which have merely been learned by ear. But in the end such a course would promote the truest interests of the blind, and ensure a more liberal support. It is far better for a blind man to be a *good mechanic* than a *poor musician*. Bad musical training in childhood unfits him for both; he will not be happy afterwards to work at a trade, and his early training will make it almost impossible for him ever to attain anything creditable in the musical profession. It is sometimes urged that it is extravagant to employ the best teachers for poor blind children. But it is more extravagant to spend money in a way that *unfits*, rather than *fits* them for useful independence. *A practical education is a blind man's capital.*

Although good teaching is indispensable, no amount of teaching, even of the best, can take the place of regular, intelligent study and practice. It is commonly supposed that the blind are indefatigable in their efforts to learn, especially music. After many years' experience, however, I am convinced that it requires more effort to obtain thorough *systematic* work from the blind than from seeing persons. Teachers of the blind not only require patience, tact, and ability, but they need a large reserve of enthusiasm to arouse and call into activity the dormant faculties of their pupils.

We must not only educate and train the blind, but also give them effectual assistance in obtaining employment. The majority of the blind, when they leave school, have neither influential friends nor money. The school, with its distinguished patronage, should speak with no uncertain sound, the students should be so trained as to deserve strong endorsement, and those who are acquainted with their character, industry, and qualifications, should take an active part in launching them in the world. All who are interested in this subject should study the systems which are now in operation in France, Saxony, and Denmark. I recommend for perusal the able papers read by M. de la Sizeranne, of Paris, and the late T. R. Armitage, Esq., M.D., at the Congress of the Blind and their friends, held at Norwood in 1890.

More than thirty years ago, during my connexion with the Perkins Institute for the Blind, in Boston, I found the professional

pupils were allowed to shift for themselves, and the great majority of these failed for the want of a little help in starting. An organised plan of practical help was introduced, and within a few years the per-centage of success among this class of students rose from about 10 per cent. to 70 or 75 per cent. When the Royal Normal College was established in 1872, two of its fundamental principles were the physical training and development of the blind, and effectual help in starting business. As a practical result, the old pupils of the college during 1890 earned about 16,000*l.*

During recent years there has been a sharp controversy upon the question of school boards, versus special schools for the blind. Many friends of the blind urge that blind children should receive their entire elementary education in ordinary schools with the seeing, whilst others, with much tenacity, claim that the work can only be done properly in special schools. I am a strong advocate of special schools, but I gratefully recognise the valuable services school boards have rendered to the cause of the blind. I believe it is a mistake to keep the children in board schools until they have passed through all the standards; it is then too late for them to begin the special training for the calling or profession by which they hope to earn a livelihood. The London School Board has adopted, as far as possible, a liberal policy, and their plan cannot be too highly commended. They have not stopped to consider the credit of passing this or that blind child through the 6th, 5th, or even the 4th standard. Their earnest inquiry has been, "What "will best promote the future welfare of our blind children?" The instruction of the blind is managed by a sub-committee, who are familiar with the details of the work. They have an energetic superintendent, who seeks out the blind children. At first they are taught in convenient centres by trained blind teachers. As soon as the children have received sufficient special instruction to enable them to work in the ordinary classes, the superintendent places them in schools near their homes, interests the head master or mistress in their welfare, and secures for them a fair share of attention. In order to keep the blind children well abreast of their work, they continue to attend the special classes at the centres two or three times a week, so that during the whole course they have a certain amount of instruction from trained teachers of the blind. The visitors assist the superintendent in finding the blind children and enforcing their regular attendance. The members of the board, superintendent, head-masters, and special teachers interest themselves in sending the children at a comparatively early age to special schools. They are encouraged to work for scholarships, and when, owing to poverty, the children are unable to enter the special school which is best adapted to their requirements, the members of the board and managers give personal aid.

The British Government has been slow to recognise its duty and privilege in the beneficent work of educating and training its blind children; but I am confident that the nation will not be satisfied until we have a complete system, not only of elementary education, but an after course of training which will so prepare all the young blind of

average ability that when they arrive at a suitable age for business, they will become producers, and not, as hitherto, sink into semi-pauperism.

I suggest the following outline as a suitable basis for a national system: *a*. School boards for the training of young blind children from four or five to about ten years of age. There will be a certain number of young blind children who from neglect, want of food, and other causes, are feeble in body and mind; such children are a great burden on any class or school, and they require special treatment and instruction. School boards throughout the country should unite, and have one special school in the most healthful locality for such children. *b*. Special preparatory schools, either under the exclusive control of school boards, or carried on by the cordial co-operation of school boards with existing special schools. *c*. At 13 or 14 years of age the preparatory course will be completed, and the pupils should be drafted according to ability and future requirements, either to trade schools, or special colleges,* where they will be prepared for the university or receive a good general education combined with high-class musical training; in connexion with the latter there should be a pianoforte tuning school.

When Government adopts a comprehensive plan for the education and training of the blind, we shall have wise, special inspection for all schools, from the lowest to the highest. The present chaos with all its petty jealousies will pass away, for the special schools will be graded from a national point of view, and each in its particular province will become an important link in the system. The blind child from the preparatory grade will be sent to the school best adapted to his gifts and requirements; the need of the child will be considered rather than this or that school.

But even when Government has undertaken and accomplished this beneficent work, much will remain to be done which must be undertaken by a National Co-operative Society composed of all existing charitable agencies for the blind. The blind, whether educated for the church, trained as teachers, musicians, pianoforte tuners, or for any other trade or occupation, require assistance at the outset. They need help in finding suitable employments, recommendations for establishing a connexion, pecuniary assistance in providing outfits of books, tools, instruments, &c., help in the selection and purchase of the best materials at the lowest wholesale rates, in the sale of their manufactured goods in the best markets, and if overtaken by reverses, judicious and timely help towards a fresh start. This will furnish a grand field of labour for all branches of the National Society. The sick and aged will also be moved to the sunny side of the hill, and the blind beggar will disappear from our streets and highways. The cry which went up from the beggar's post at the gates of Jericho more than 1,800 years ago still vibrates upon the ears, and moves the hearts of men. Charities have been

* A well devised system of scholarships should be established, open to both sexes, and so arranged as to awaken the ambition of the blind throughout the country.

created, asylums, homes, and schools have been established, but the blind as a class are still floating helplessly down the stream of pauperism. Tens, even hundreds, of thousands of pounds are obtained for technical schools and colleges of music! Scholarships are multiplied even for the wealthy who have sight! All honour to those who are doing so much for the cause of education. Shall less be done for the blind? Shall we not lift up the weak hands and strengthen the feeble knees? The blind plead for a thorough, comprehensive education, which will give them strong bodies, well-disciplined minds, and courageous souls. Then, and not till then, will the blind, as a class, become productive members of society. Therefore I ask you to pass the following resolution:—

"That the time has arrived when the Blind should have a well-graded, practical, comprehensive course of instruction. That the training of the Blind should not be conducted on a charitable basis, but should form part of a National system of education."

Within the last hundred years many systems of reading and writing have been devised, in which books have been embossed. The multiplicity of systems has greatly increased the cost of production, and much restricted the supply of embossed literature at the disposal of the blind. One sample will be sufficient to illustrate the results of the want of co-operation. The bible has been printed in at least seven different systems for the English-speaking blind; consequently, while the seeing can have a copy of the bible for a few pence, a corresponding copy for the blind, will cost as many pounds. If all the bibles used by the English-speaking blind were in one type and produced by one press, an enormous reduction in cost would be effected. As the number and influence of intelligent blind persons is rapidly increasing, we confidently anticipate that the principle of co-operation will effect important reforms in the affairs of the blind. Already many embossed systems are becoming obsolete. During the past 20 years, the main controversy has turned upon the question of "dots" versus "lines." If this question could be settled by the blind who have to use the books, they, by a large majority, would choose dots instead of lines. Dots can be read and written with great facility by the blind of all ages. The blind are even able to prepare the stereotype plates for embossing their own books. Unfortunately we have two systems of point writing; the Braille and New York point. In 1874, and again in 1878, Dr. Armitage, on behalf of the British and Foreign Blind Association, proposed to the Convention of American Educators of the Blind the appoiniment of an international committee, composed of an equal number of American and English members, to whom the whole subject should be referred, on condition that both parties would agree to accept the decision of the international committee, and thus have only one dotted type for the English-speaking world. Unfortunately, the proposition was not entertained.

The British and Foreign Blind Association, under the leadership of the late Dr. Armitage, its inspired founder, devoted much time to the careful investigation of the complicated subject of types. As Dr. Armitage during the last twenty-five years of his life devoted his entire time

and fortune to the interests of the blind, I give the following in his own words:—

"We have now to consider the systems in which the characters are formed by various arrangements of dots. Of these, the most important is that invented by M. Louis Braille, a blind pupil of the Institution des Jeunes Aveugles, in Paris. This was introduced in 1829, and has now became the only method used in France, both for printing and writing. It is almost exclusively used in every school for the blind in Europe, British North America, Mexico, Brazil, Australia, Egypt, and in several institutions of the United States. It has been recommended for adoption by every European congress of educators of the blind since 1878.

Its signs are arbitrary, and consist of varying combinations of six points, placed in an oblong, of which the vertical side contains three and the horizontal two points. There are 62 possible combinations of these six points, so that, after the requirements of the English alphabet have been supplied, there remain a sufficient number of signs for punctuation, contractions, &c.

For writing, a frame is used consisting of a metal bed, marked by groups of little pits, each group consisting of six. These are arranged in two parallel lines, and a guide is hinged on this bed in such a way, that when the two are locked, oblong holes in the guide correspond exactly to the pits in the bed. The paper is introduced between the guide and the bed. The instrument for writing is a blunt awl, which carries a little cap of paper before it into the pits of the bed, thereby producing a series of pits in the paper. When the paper is taken out and turned over, little prominences are felt corresponding to the pits on the other side. When the first two lines have been written, the guide and bed travel as one piece down the board, which is so arranged as to give the right distance between the lines. Each line is separated by a wide interval from the next, which greatly facilitates reading. When the first page has been written, the paper is reversed, and the lines of the second page are written in the intervals between those of the first; a simple mechanical contrivance enables a blind person to do this with ease and certainty. This interlined writing not only makes the writing far more legible than that produced in the original French frame, but also effects a saving of space amounting to about 20 per cent.

"The group of six dots, which is the largest number of points that any letter can consist of, is divided into upper, middle, and lower pairs. The first 10 letters, from "a" to "j," exhaust all possible combinations of the upper and middle points. The next 10, from "k" to "t," are formed from the first by adding a lower back point each. Thus "a" becomes "k," "b" becomes "l," &c. The third row is similarly formed by adding two lower points. Thus "a" becomes "u," "b" becomes "v," &c. Reading is much facilitated by the use of a few simple and well-chosen contractions, as words being rendered shorter, the finger has less space to traverse.

"A modification of the Braille system was suggested by the late Dr. Russ, of New York, and it has been ably and strenuously advocated

by Mr. Wait, the superintendent of the Institution of the Blind in that city. The New York frame is so constructed as to allow letters to be formed of one or two points vertically, and of one, two, three, four, or more points horizontally. This is attained by having four-sided openings in the guide, at each corner of which a point can be made on the paper, these openings being separated from each other by intervals equal to the horizontal distance between the points, so that letters whose length is one point horizontally occupy half a cell, those of more points may occupy a whole cell, or two or three contiguous cells. The intervals between letters are obtained by omitting one point, and between words by omitting two or more points. Each letter, therefore, occupies no more space than is absolutely required for its formation.

"The result of the investigation, which terminated in the final decision in favour of the Braille system, may be briefly summed up as follows:—

"1. The gain in space of New York over Braille is said, theoretically, to be 30 per cent. Practically, this was found to be somewhat over-estimated. This gain in space is the principal advantage, though there seems also to be a slight gain in rapidity of writing. There are, however, some serious disadvantages to compensate for this gain in space.

"The New York system does not lend itself so well to interlining as the Braille, in consequence of the difficulty in distinguishing the characters which are composed entirely of upper or entirely of lower points.

"In distinguishing such characters from each other the reading finger is guided, to a considerable extent, by the interval which occurs between the upper or lower points, as the case may be, and the next line, and, as this is not possible with wide lines, it follows that interlining is not well suited to the New York character; and if we compare the interlined Braille with the close-lined New York, it will be found that the gain in space of the New York has disappeared, while the Braille is far more legible.

"2. The New York system is poorer in signs than the Braille, unless characters four points in length are used, and these are too long to be covered at once by the finger, which is inconvenient; hence, probably, the omission of many punctuation signs in the New York books, which produces inaccuracy and ambiguity.

"3. The correction of written or printed matter is very much more difficult in the New York than in the Braille system—a point of very great practical importance.

"4. As the letters in Braille are formed from each other by a simple rule, this system is more easily learnt than the New York, where there is no such aid to memory. This is of very little importance in schools where children are obliged to learn; but becomes of consequence when adults not in insti-

tutions are learning, as they readily become discouraged unless the first steps are made easy to them.

"5. As the different etters occur with varying frequency in different languages, it follows that if the New York system were generally adopted, each language would have a different alphabet, and the difficulty of reading foreign languages would thereby be greatly increased.

"6. The Braille system is too firmly rooted in Europe ever to be changed, and it would be a great calamity to the blind to have two point systems, unless the new were greatly superior to the old. This objection applies with still greater force to the musical notation, which ought to be as universal among the blind as it is among the seeing. Great numbers of valuable musical works have already been published in Paris, London, Copenhagen, and elsewhere. These would be illegible by, and useless to, the pupils of an institution using the New York system for musical notation, the adoption of which could only be excused by great superiority, and it is by no means proved that the New York musical notation is even as good as the Braille."

All who are acquainted with the two systems will probably agree that the New York interval gives great advantages over the Braille interval. Unfortunately Dr. Russ sacrificed these advantages by reducing the depth of the letters from three to two points. At the American Convention in 1874, and again in 1878, I strongly urged that we should construct an alphabet with the New York interval while we retained three points in depth. By this arrangement we should have retained the best features of both systems. By combining the New York interval with the Braille depth of three points we greatly increase the number of possible characters without increasing the length beyond three points. More than 50 per cent. of the English alphabet is represented by the letters a, e, i, n, o, s, and t. By the plan I suggested, these seven letters could be represented by characters only one point in length, and the effect is obvious. Many natural contractions would be available, for instance "in," "on," "oo," "os," "ss," and many other combinations of letters could be written without interval, effecting a great saving of space, and at the same time improving the legibility. We should have a very simple alphabet containing at least 25 per cent. less dots than the New York, consequently the labour of writing would be much less, and at the same time the type would be more readable; the musical notation would be even more improved than the literary system. But the evils arising from the multiplicity of systems has deterred me from urging this plan. In my opinion, a new system ought not to be introduced, unless it commands the support of a large majority of the intelligent blind and of their friends and educators.

The Physical, Manual, and Technical Education of Deaf Mutes.

BY

General MOBERLY, Chairman of the Sub-Committee on the Instruction of the Blind Deaf and Dumb, London School Board.

In the remarks which I am invited to address to you, I propose to confine myself entirely to such points as bear any relation to the instruction given to deaf mutes by the School Board for London.

Shortly after the Board was fairly established, viz., in September 1874, it set apart a class-room in Wilmot Street, into which five children were admitted; in January 1875, another class was organised in Winchester Street; in October 1875, a third was opened in Marlborough Street temporarily, and transferred in June 1876 to Victory Place, at which time another centre was established in Bell Street.

In these schools, and down to June 1877, deaf teachers were employed to educate only under the sign and manual system. Dr. Stainer, the Superintendent, was the sole instructor of such few as he thought capable of learning orally; but at this date the Board employed a hearing assistant to aid him in this further accomplishment.

During the period between this and September 1881, no new deaf teachers were engaged in the place of those who resigned their employment under the Board, and gradually their places were occupied by hearing teachers, who, under general instruction from the Board, were required to teach only by the oral method, and of whom very few were acquainted with the sign and manual system.

All the educational work of the Board is carried out in *day* classes. The attendance of children under the Education Act of 1870 is theoretically compulsory, and extends to all children between the ages of 5 and 13; blind, deaf, crippled, &c., are included; in practice, however, the regulations have failed in a most disappointing degree.

In London the magistrates have generally shown great sympathy with the parents; those of the latter who are really anxious for the welfare of their children, have given the officers of the Board very little trouble, but have incited the children themselves to make the most of the opportunities given to them. The thriftless, poorly educated members of the population, on the other hand, constantly require the presence at home of their children to run about little jobs which they might easily execute themselves, if they possessed any idea of order or method; to run on errands for them, or for somebody who would pay a small pittance, utterly forgetful that in consequence of this little present convenience they are throwing away immense advantages in the future.

This feeling on the part of magistrates of kindness and sympathy, really very ill-founded, is extended largely towards any afflicted child, I believe throughout, very much from ignorance on all sides. Parents will rarely acknowledge, even to themselves, the existence of any defect in their child, and use every endeavour to conceal the knowledge of

it from others after they are compelled to admit it to themselves. In many cases they flatter themselves that the malady is only temporary, that the child will grow out of it, and that it may be cured or alleviated by medical treatment, and by home and parental kindness; and there is a very strong inclination, no doubt in many cases well-founded, to believe that any attempt at instruction is likely to injure the child, to delay or prevent its perfect restoration to health and soundness.

These difficulties, common to all children who are in any degree afflicted, are enhanced by the surprising ignorance prevalent in the world as to the power of teaching deaf mutes, and as to their capacity for learning by other senses than that of hearing. The general feeling, so far as my experience goes, is that these children are nearly idiots, and beyond all means of instruction. In exceptional cases, where a deaf-mute has been taught anything, it was considered almost miraculous, and the child a prodigy. The number of deaf-mutes is not very great, and few among us are brought into immediate or frequent contact with them; and it is only in case of special assistance being required, that even one of our ordinary charitable and beneficent workers is led to inquire into the means of procuring help and instruction for the individual in whom he or she is personally interested.

As to the extent to which the education of deaf-mute children has been carried, there exists most striking ignorance; to speak for myself, I may say that during many years of my life I met with only one child, and she was in a temporary orphanage, among a large number whose parents had either died during one of our great famines in India or who had deserted them temporarily in the hope that they would be cared for better in their destitute condition. During some years of work in London I came across no such afflicted children; and until I joined the Sub-Committee of the School Board charged with the superintendence of the abnormal classes, I had not thought of the subject. During the last three years I have similarly found want of information among the ministers of various denominations, whose ordinary avocations bring them into immediate contact with the poor, and among the teachers in our schools, from whom I certainly expected better knowledge. More than one has brought to my notice the case of a child, who, they informed me with great surprise, had certainly some power of utterance, and they have been astonished to hear that speechlessness was very unusual, and that people were dumb only because they had never heard the words or sounds which they themselves had acquired the use of only by following the directions of their parents and teachers, and which they were themselves communicating to their pupils.

They have been surprised to hear that at no great distance from the school there were central classes in which children were being instructed in reading and writing through their power of imitating actions of lips and hands which they were taught to follow. There are now 16 such centres, with a varying number of classes under 43 teachers, in which there are enrolled 425 children.

Many of the teachers of ordinary schools had heard of an alphabet on the hands by which some communication could be made with the

exceptionally gifted deaf and dumb. But few were aware of the great success which had attended the endeavours to obtain intelligible utterance from the deaf-mute generally, and this in classes on the premises of some schools under the Board.

It is to this ignorance on the part of parents and teachers, and in some degree of our visitors, that I attribute the fact that many children are not brought into our classes till they are considerably above the age at which it is considered advisable to begin their education. This is, I find, generally held to be seven years, and the endeavour to teach at an earlier age was considered by a teacher (for whom I have the highest respect) unsatisfactory, because if a child under seven is taken he must be educated on what he calls the "play" system, and treated so leniently that he will afterwards object to being taught in any other manner. I may say in passing that a deaf child of seven years of age is considered to be in about the same phase of intelligence as a hearing child of five.

My first objection to this statement is, that if we do not teach a deaf child till he is seven years old, he will necessarily acquire a system of communication with his relations and neighbours, "natural signs" as experts call them, and he may similarly "object to being taught in any other manner."

One very strong supporter of the oral system, says, "It is impos-
" sible for deaf children to have the full benefit of a pure oral system
" if they have at any time been taught on another system or are
" allowed to become acquainted with the manual alphabet, or system
" of signs." I cannot reconcile the two opinions as to the advisability of refraining from educating deaf children under seven years of age, and the impossibility of teaching them language if they have acquired any means of communication by signs.

But further, I think the remark as to the "play" system is most fully and forcibly answered by the universally acknowledged success of the Kindergarten methods. We have mere babies in our ordinary schools learning many things in the purest play, and find no difficulty in passing them on to more earnest and serious methods of acquiring knowledge.

Many of them have as little, or very little more, language than our deaf children when they first enter school; and as it appears to me, we have only to turn to account the power of imitation by sight which the children possess in a strong degree, and which they exercise naturally very much.

I cannot vouch for the truth of a tale which I read or heard a short time ago of a deaf and dumb cow, who followed the action of her companions in the herd, in thrusting out her head and going through the action of lowing, but without uttering any sound.

Our experts have discovered the method of obtaining the further accomplishment of articulation, but I have myself seen an instance of failure of procuring the sounding of vowels.

I do not propose to enter into the comparative merits of the pure oral or of the manual systems of educating the deaf. I fully acknowledge the great advantage to a deaf person that he should be able to communicate with the world in general, which he can do *only* by possessing and using the power of speech; but under the circumstances of our position in the day schools under the London Board, I am satisfied that we cannot teach *all* our pupils orally; and I am very glad that the Board have permitted the instruction by signs in one class, where the progress made by boys who were considerably backward has been very satisfactory.

In many cases children have been discovered and compelled to attend who were much above the age at which it is thought practicable to teach articulation; they have acquired other methods of communication, which they continue to practice in their homes and in the streets, because their companions, and frequently their parents also, have not the time and patience necessary to understand broken syllables and imperfect pronunciation.

There is moreover a further difficulty, not unknown in our hearing classes, that the simple grammatical English of our reading books is not the mother-tongue commonly used.

Where parents or relations take a real interest in the teaching of the children there is good ground for believing in great success in teaching and maintaining the use of speech; but I submit that imperfect instruction is useless, and not productive of any advantage. The child who cannot speak intelligibly, or whose voice is harsh and irritating, will be avoided, and will give up his acquired power even more quickly than he attained it.

I have been somewhat surprised at the capacity for reading the lips of their teachers and schoolfellows shown by many of the pupils in our classes, but I fear very few of them are sufficiently advanced to understand strangers and casual visitors. Practice of this branch of instruction would certainly improve their means of communication, and should be encouraged even if the pupil did not articulate well or pleasingly.

Our object is to impart knowledge, and to impart as much as we can in the time allowed by the various circumstances of attendance and capacity of our children. If children are admitted at an early age, I would use every endeavour to teach language and lip reading for, say, one year, as recommended by the Royal Commission, and after that would continue the system or remove the child to a separate class where the sign and manual method is carried on, according to each pupil's ability and aptitude.

I believe that much more may be done towards perfect instruction in an institution where all persons about them are concerned in forwarding the systematic education, than in the ordinary life to which many of our London children return from their classes.

I would encourage in every way the mixing of deaf with hearing children wherever parents or friends would earnestly and heartily co-operate in

our endeavours. The lessons in cookery given to our older girls have been of service in bringing them into more social communication with hearing girls, and I hope that physical exercises which have been lately introduced will have the same effect, as well as improve their health and bodily condition. It is also intended to send these children to the laundry classes which have been lately established by the Board.

I look forward also to carrying our more advanced pupils into the drawing and technical classes of the ordinary school. They show great aptitude for writing, perhaps because of its use in communicating while learning speech, and in the Homes * I find some of them doing very satisfactory and good work in wood-carving, &c. The fact that they see they can do things like others, as well as, and in some cases, better than they, is highly conducive to opening their minds, and to fostering a healthy emulation.

Zur Hygiene der Sprache des Kindes.

VON

Dr. H. GUTZMANN, Berlin.

Das Thema, worüber ich vor Ihnen zu sprechen die Ehre habe, wird wohl selten oder auch nie auf diesen Versammlungen berührt worden sein.

Die Sprachheilkunde ist erst ein Kind unserer neueren Zeit. Leider sind aus früheren Jahrhunderten, ja selbst aus früheren Jahrzehnten keine Statistiken über die Verbreitung von Sprachstörungen vorhanden, wenn auch aus zahllosen Stellen der Weltlitteratur hervorgeht, dass es zu allen Zeiten und unter allen Völkern Störungen der Sprache gegeben hat. Deswegen ist es auch schwer nachzuweisen, ob sich in unserer Zeit die Sprachstörungen vermehrt haben oder nicht. Jedoch erscheint mir aus rein sozialen Gründen hervorzugehen, dass die Pflege der Lautsprache sich verschlechtert hat. In unserer rastlos dahin eilenden Zeit, in der sich Alles im Kampfe um das Dasein, im Kampfe um das tägliche Brod jagt und hastet, giebt es unter dem Arbeiterstande kaum noch ein ruhiges und gemüthliches Familienleben, Mann und Frau müssen arbeiten, um den nöthigen Lebensunterhalt zu erwerben, die körperliche und noch mehr die geistige Entwickelung der Kinder wird dabei natürlich vernachlässigt, selbst im guten Mittelstande ist dies nicht viel anders.

Die Pflege der Lautsprache des Kindes ist zwar nur ein kleines Gebiet der gesammten Kinderhygiene, ist aber darum sicherlich nicht

* Maintained by Dr. Stainer by other means and contributions apart from the Board, which undertakes only elementary instruction.

minder wichtig. Heute erfordert mehr als jemals fast jeder Beruf und jede Lebensstellung die vollendete Beherrschung der Lautsprache, und wenn man sieht, wie sonst tüchtige Menschen durch irgend eine Störung ihrer Sprache selbst bei Ausübung eines gewöhnlichen Handwerkes den Mindertüchtigen, aber Sprachgewandteren nachgestellt werden, so ist es sicherlich auch unsere Aufgabe, über die Mittel nachzudenken, welche derartige Zustände verhindern können.

Die Hygiene der Sprache wird natürlich am wirkungsvollsten zur Zeit der Sprachentwickelung selbst angewandt werden, d. h. im Kindesalter; die Art der sprachhygienischen Einwirkung ergiebt sich naturgemäss aus der Art und Weise, in welcher die Sprachentwickelung des Kindes zu erfolgen pflegt. Ohne auf Vollständigkeit Anspruch machen zu wollen, möchte ich in diesem Vortrage versuchen, einige wesentliche Gesichtspunkte für die Hygiene der Sprache des Kindes auf Grund der Sprachentwickelung aufzustellen.

Die sprachliche Entwickelung des Kindes vollzieht sich nach Kussmaul in drei Perioden.

I. Die ersten Sprechversuche treten schon vor Ablauf des ersten Vierteljahres ungefähr zu derselben Zeit ein, wo das Kind die ersten greifenden Bewegungen macht. Besonders in behaglicher Stimmung versucht sich der Säugling in der Hervorbringung der mannigfachsten und merkwürdigsten Lippen- und Gaumenlaute, die bereits an die gewöhnlichen Laute seiner Muttersprache erinnern, wenn sie auch noch nicht deren fest ausgeprägte Gestalt haben.

Kussmaul nennt diese Laute "wilde Laute" und glaubt in ihnen die den Menschen von Anbeginn verliehenen Urlaute zu sehen, welche sich im Laufe unzähliger Generationen zu allen den Lauten ausbildeten, die in den Alphabeten der heutigen Volkssprachen enthalten sind. Er hält sie für rein reflektorischer Natur und für ein Erzeugniss desselben Muskelbetriebes, welcher das Kind antreibt, mit den Händchen um sich zu schlagen und mit den Beinchen zu strampeln und dadurch seine Muskeln für das spätere Greifen und Gehen zu stärken und auszubilden.

In dieser ersten Periode der Sprachentwickelung ist von irgend einer sprachhygienischen Einwirkung natürlich keine Rede.

II. Die zweite Periode der Sprachentwickelung. Preyer u. A. betonen, dass alle neugeborenen Menschen taub oder harthörig sind, und dass sich das Gehör in den ersten Lebenstagen nur langsam verschärft, dass also eine kurze Periode physiologischer Taubstummheit bei jedem Kinde vorhanden ist. Die Hörfähigkeit entwickelt sich allmählich, und die zweite Periode der Sprachentwickelung kennzeichnet ihren Eintritt dadurch, dass das Kind horcht und Töne unterscheiden lernt, wobei fast zu gleicher Zeit der Nachahmungstrieb "in seiner ganzen ursprünglichen Macht" zum Vorschein kommt und die wilden Urlaute allmählich durch die gebräuchlichen Laute der Volkssprache verdrängt. Die elementare Macht der Nachahmung zeigt sich so recht in dem von Herodot beschriebenen Experiment Psammetich's, welcher zwei neugeborene Knäblein vollständig aus der menschlichen Gesellschaft

entfernte und durch Ziegen auffüttern liess. Die Kinder sollen dann nach zwei Jahren zuerst das Wort "Bekos" ausgesprochen haben, wie Techmer hinzufügt: "Keine üble Nachahmung der Sprache ihrer Ammen."—Schon frühzeitig erwacht bei den Kindern der musikalische Sinn. Sigismund erzählt, dass sein Knabe mit ihm Melodien sang und dieselben nachahmte, noch ehe er Worte nachzuahmen vermochte. Vielleicht ist es auch dieser Umstand, der Goethe zu dem Ausspruche veranlasste, dass die Musik die Grundlage der Erziehung bilden müsse.

Die Nachahmung der Worte schreitet aber nicht mit dem Verständniss derselben in gleicher Weise vorwärts. Die Kinder "verstehen einzelne, ohne sie nachzuahmen und ahmen viele nach, ohne sie zu verstehen."

Ferner ist wichtig, dass fast immer ein Missverhältniss besteht zwischen der Lust an der Lautnachahmung und der Geschicklichkeit der dazu benöthigten Muskulatur. Endlich ist es für die Beurtheilung und Prognose mancher Fälle von scheinbarer Aphasie von Bedeutung, dass die Lust an der Lautnachahmung bei den verschiedenen Kindern zu sehr verschiedener Zeit erwacht, und es scheint nach Preyer so, als ob die Mädchen den Knaben voraus wären, sowohl was die Geschicklichkeit als was die Lust zum Nachahmen betrifft.

In dieser Periode haben wir bereits die ersten wichtigen Anhaltspunkte für eine systematische Sprachhygiene. Von pädagogischer Seite wurde es längst anerkannt, "dass die Sprachbildung der Kinder von früh an eine ernste Sorgfalt erfordert," (Joh. Friedr. Herbart) und Pestalozzi war der Erste, der diesen Gedanken praktisch durchführte, als er sein Buch für die Mütter schrieb. Die einzelnen Gesichtspunkte sind folgende:

1. Das sprachliche Vorbild des Kindes muss möglichst gut sein.— Je besser und deutlicher vorgesprochen wird, desto leichter ahmt es auch nach.

2. Schlechte sprachliche Vorbilder müssen sorgfältigst von dem Kinde ferngehalten werden. Die Nachahmungsfähigkeit der Kinder ist so ausserordentlich gross, dass man in diesem Punkte nicht vorsichtig genug sein kann. Besonders muss man den Eltern rathen, zunächst selbst zu dem Kinde nur exakt und scharf artikulirt zu sprechen, ferner bei der Wahl einer Amme oder Kinderfrau auch die Sprache derselben zu berücksichtigen. Ich habe von Sprachfehlern, welche auf diese Weise bereits im frühesten Kindesalter entstanden waren, die merkwürdigsten Beispiele gesehen, so handelte es sich in einem Falle um vier Geschwister, welche sämmtlich nach dem Vorbilde der Amme die s-Laute aus dem rechten Mundwinkel hervorzischten. Als diese vier Geschwister erwachsen waren, pflanzte sich die üble Angewohnheit auf das Kind eines derselben fort. Die anderen hatten ihren Kindern schon Namen gegeben, in denen kein s-Laut vorkam, und entzogen sich soviel als möglich dem Umgange mit ihren Kindern, um nur die Uebertragung zu verhüten. Genau denselben Fehler habe ich in einer anderen Familie auf drei Kinder ebenfalls durch die Amme übertragen werden sehen.

In einer dritten Familie hatte ein Kind ein wendisches Kindermädchen, und die Folge davon war, dass es neben zahlreichen anderen Fehlern der Aussprache den gehauchten Vokaleinsatz nicht zu machen im Stande war, es sprach statt Hut: ut, statt Hanna: Anna.—Führen wir noch zu den oben genannten beiden Punkten einen Ausspruch Pestalozzi's an, der gerade für das gute Vorsprechen von Bedeutung ist:

"Es stellt sich Niemand vor, der es nicht gesehen, in welchem Grade das Vorsprechen dieser einfachen Töne ba ba ba, da da da, ma ma ma, la la la u. s. w. die Aufmerksamkeit unmündiger Kinder rege macht und für sie Reiz hat, ebenso wenig, was durch das frühe Bewusstsein dieser Töne für die allgemeine Lernkraft der Kinder gewonnen wird."

Aus diesem Ausspruch geht auch hervor, dass man

3. Kindern, welche geringe Lust an der Lautnachahmung zeigen, möglichst viel vorsprechen und in der Bemühung, sie dadurch zum Nachahmen anzuregen, nicht erlahmen soll.—

Da die Reihenfolge der Entwickelung der einzelnen Sprachlaute eine, wenn auch nicht immer gleiche, so doch ähnliche ist, welche ganz naturgemäss von der Leichtigkeit der Bildung derselben abhängt, so soll man sich auch

4. bei diesen Vorsprechübungen ungefähr an die Reihenfolge dieser Entwickelung halten. Die von Fritz Schulze aufgestellte Lautentwickelungsreihe, welche nicht aus einer einzigen Beobachtung resultirt, sondern aus einem Beobachtungsmaterial, das er selbst allerdings noch lange nicht für genügend hält, ist folgende:

Er findet, dass die physiologische Schwierigkeit in der Richtung von den Lippen zu den Gaumenbuchstaben wächst, und dass deshalb bei dem Kinde die letzteren am spätesten hervortreten. Fritz Schulze stellt sechs Stufen des sprachlichen Könnens beim Kinde auf. Die erste Stufe wird durch die Konsonanten p, b, m, f, w, d, n, die zweite durch l und s, die dritte durch ch und j, die vierte durch sch, die fünfte durch r und die sechste durch ng, k und g dargestellt.—Wo also das Vorsprechen nothwendig erscheint, wird man gut thun, auch die Laute möglichst in dieser Entwickelungsweise einzuüben, ohne sich jedoch pedantisch an dieselbe zu halten, da man stets zufrieden sein muss, wenn das Kind einen neuen Laut erlernt, und da erfahrungsgemäss die Reihenfolge, in welcher die einzelnen Laute auftreten, individuell sehr ungleich ist (Preyer).

III. Die dritte Stufe der Sprachentwickelung charakterisirt sich dadurch, dass das Kind mit den eingeübten Worten bestimmte Objektbilder zu verbinden lernt, dass dadurch die Sprache als Gedankenausdruck des Kindes dient. Auf dieser Stufe der Sprachentwickelung tritt das oben angedeutete Missverhältniss zwischen Sprechlust und Geschicklichkeit der Sprechmuskulatur häufig sehr auffallend in die Erscheinung. Oft macht es, besonders wenn die Kinder, wie Preyer hervorhebt, unter Anwendung eines unnöthig starken Exspirationsdruckes zu sprechen versuchen, den Eindruck von wirklichem Stottern.—Verschiedene schwerer zu bildende Laute werden

von den Kindern durch leichter zu bildende ersetzt. Häufig zeigt sich die Erscheinung des Silbenstolperns, auch die des "Sichversprechens." (Skoliophasie—Preyer.) Alle diese Unvollkommenheiten der kindlichen Sprache sind wichtige Anhaltspunkte für die Sprachhygiene. Diese Punkte sind folgende:

1. Da das Kind durch das beschriebene Missverhältniss zwischen Sprechlust und Geschicklichkeit der Sprechmuskulatur in Gefahr gerathen kann, Stottern oder Poltern zu erwerben, so müssen seine Sprachleistungen unter fortwährender Leitung und Aufsicht gehalten werden. Ich führe hier einen Satz Albert Gutzmann's, meines Vaters, an, der mir die wesentlichsten praktischen Massnahmen zu enthalten scheint, die man gegen die genannte Gefahr ergreifen kann:

"Das Kind ist in allen seinen Handlungen wenig berechnend, häufig planlos, unbeständig, eilt von einer Beschäftigung zur anderen Es fällt oft weniger aus Mangel an Körperkraft, als aus Uebereilung und Unvorsichtigkeit. So ist auch seine Denkthätigkeit. Die Gedanken jagen, überstürzen sich, und dies findet seinen Hör- und sichtbaren Ausdruck im Sprechen. Das Kind geht nicht in seinen Worten, sondern es läuft oder überstürzt sich. Die Folge davon ist, bei der noch unzureichenden Geübtheit des Denk- und Sprech-Instrumentes ausser anderen Fehlern auch das Stottern. Darum bedarf das hierzu neigende Kind einer verständigen Führung in seiner Denk und Sprechthätigkeit und darf sich in seiner Sprachentwickelung nicht selbst überlassen bleiben. Das Kind hört gern Märchen und Geschichten. Man erzähle sie ihm in kurzen, logisch zusammenhängenden Sätzen und lasse jeden Satz von ihm langsam und möglichst lautrein nachsprechen.

"Dann frage man in angemessener Form und lasse ebenso langsam die Antworten geben. Die Aussicht auf eine neue Geschichte schafft dem Kinde die nöthige Geduld und Ausdauer. Das Kind hat auch Bilder lieb. Man gebe sie ihm und knüpfe daran für seinen geistigen Standpunkt passende Sprechübungen. Kinder fragen auch gern und viel. Man lasse sich dies nie verdriessen, sondern benutze auch diesen Trieb zur Förderung normalen Sprechens."

In Bezug auf Bilder sei erwähnt, dass ein vernünftig geleiteter Anschauungsunterricht ausserordentlich viel zu einer gedeihlichen Sprachentwickelung beizutragen vermag.

Ich kann als ein Hülfsmittel dazu "Bohnys neues Bilderbuch," welches im Jahre 1885 in zwölfter Auflage erschien und wegen seines wirklich praktischen Werthes in neun fremde Sprachen übersetzt wurde, nicht genug rühmen und empfehlen. Die Fragen, wie sie dem Anschauungsvermögen der Kinder entsprechend gestellt werden müssen, sind unter die betreffenden Bilder untergedruckt, und es ist demjenigen, der den Anschauungssprachunterricht zu leiten hat, auf diese Weise ausserordentlich bequem gemacht, so dass das hübsch ausgestattete Buch in der Hand jeder Mutter seinen Zweck erreichen wird.

2. Die Kinder können in der dritten Periode der Sprachentwickelung meist noch eine Reihe von Lauten nicht richtig sprechen, oder sie setzen statt einiger schwererer Laute, andere leichter zu bildende Laute ein (Stammeln). Natürlich ist diese Erscheinung bis zu einem gewissen Alter der Kinder physiologisch, kann indessen bei mangelhaft geleiteter Uebung leicht zu einem dauernden Sprachfehler werden. Durch fortwährendes richtiges Vorsprechen kann man hier sehr viel erreichen, wie dies bereits früher hervorgehoben wurde.

3. Die Sprachentwickelung ist bei fast der Hälfte der Kinder noch nicht vollendet, wenn sie die Schule besuchen. Ueber die Sprachstörungen unter der Schuljugend habe ich mich bereits in mehreren Veröffentlichungen* des Weiteren ausgelassen, so zuletzt in der Sektion für Kinderheilkunde auf dem X. internationalen medizinischen Kongress in Berlin. Ich will hier der Vollständigkeit halber nur die Resultate meiner Untersuchungen anführen. Von den in die Schule aufgenommenen Kindern, die sich meistens im Alter von 6 Jahren befinden, und von denen, wie schon gesagt, mindestens noch die Hälfte in der Sprachentwickelung steht, leiden bereits 0·5% an Störungen der Sprache: Stottern und Stammeln. Diese Sprachstörungen nehmen in der Schule selbst so ausserordentlich zu, dass sie sich im zweiten Schuljahre bereits auf 1% aller Kinder erstrecken. Am Schlusse der Schulzeit—d. h. bei den Kindern der Volksschule im Alter von 14 Jahren—leiden bereits 1·5% aller Kinder an Sprachstörungen. Ich habe diese Resultate aus zahlreichen Statistiken gewonnen, die sich auf über 200,000 Kinder erstrecken, und es geht daraus hervor, dass sich in Deutschland allein 100,000 stotternde oder stammelnde Schulkinder befinden. Ich weiss nun zwar nicht, ob in anderen Ländern ähnliche Zählungen über die Ausbreitung der Sprachstörungen unter der Schuljugend gemacht worden sind, das aber scheint kaum dem Zweifel unterworfen zu sein, dass auch in den anderen zivilisirten Ländern der Prozentsatz nicht bedeutend abweicht.

Die einzige Möglichkeit, eine derartige Ausbreitung der Sprachstörungen zu verhüten, sehe ich in einer energischen Hygiene der Lautsprache, wie sie beim ersten Leseunterricht angewandt werden kann und soll. Nothwendig dazu ist, dass die Lehrer, welche denselben ertheilen, die nöthigen sprachphysiologischen und sprachhygienischen Vorkenntnisse in ihrer Ausbildungszeit erwerben. Dafür Sorge zu tragen, ist die Pflicht jedes Staates.

---

* Hermann Gutzmann, Die Verhütung und Bekämpfung des Stotterns in der Schule. Leipzig 1889.

Ferner: Ueber die Sprachgebrechen unter der Schuljugend, Verhandlungen des X. internationalen medizinischen Kongresses 1890. Bd. II., Abth. 6.

Ueber die Sehschärfe der Schüler.

VON

Dr. med. et phil. L. Kotelmann, Augenarzt in Hamburg.

Bei dem regen Weltverkehr, dessen sich Hamburg als die erste Handelsstadt des europäischen Kontinents erfreut, habe ich wiederholt Gelegenheit gehabt, die Augen solcher Individuen, welche Naturvölkern angehörten, zu untersuchen. Dabei ist mir jedesmal die ausserordentliche Sehkraft derselben aufgefallen.

So hatten von 7 Lappländern die 3 Erwachsenen im Durchschnitt eine Sehschärfe von 2·25, die 4 Kinder eine solche von 2·38.

Bei einem 43jährigen Patagonier betrug dieselbe auf jedem Auge 2·15, bei einer 27jährigen Patagonierin 2·0, bei einem 5jährigen patagonischen Knaben gleichfalls 2·0.

Aehnlich fand ich bei 10 erwachsenen Nubiern eine mittlere Sehschärfe von 2·56, bei 3 jüngeren Nubiern eine solche von 2·67.

Von 17 Kalmücken besassen 15, welche 17 bis 35 Jahre alt waren, ein durchschnittliches Sehvermögen von 2·88, 2 Mädchen im Alter von 15 Jahren ein solches von 2·04.

Endlich konstatierte ich bei 18 erwachsenen Singhalesen im Mitte, eine Sehschärfe von 2·06, bei 2 singhalesischen Kindern eine solche von 2·23, während 3 Hindus im Alter von 20 bis 45 Jahren eine durchschnittliche Sehschärfe von 2·05 hatten.

Bei der Beurteilung dieser Zahlen ist freilich zu berücksichtigen, dass die Untersuchungen unter freiem Himmel, also bei besonders guter Beleuchtung, stattfanden und dass als Probeobjekte die *Snellen*schen Hakenfiguren verwendet wurden, welche ungefähr um $\frac{1}{4}$ weiter als die *Snellen*schen Probebuchstaben gesehen werden.

Es erschien nun die Beantwortung der Frage von Interesse, ob nicht auch bei den Kulturvölkern wenigstens jugendliche Augen eine ähnliche Sehschärfe wie die Naturvölker zeigen, vorausgesetzt dass sie unter gleich günstigen Verhältnissen zur Untersuchung gelangen.

Eine erwünschte Gelegenheit zu einer solchen Untersuchung bot sich mir bei den Schülern des Gymnasium Christianeum in Altona. Hier konnte ich die Augen nicht nur während der hellsten Tagesstunden von $12\frac{1}{2}$ bis $2\frac{1}{2}$ Uhr prüfen, sondern diese Prüfung auch in der grossen, durch 6 hohe Fenster glänzend beleuchteten Aula mit aller Sorgfalt vornehmen.

Als Probeobjekte dienten wieder die *Snellen*schen Haken, welche an der den Fenstern gegenüberliegenden Wand in Augenhöhe befestigt waren. Die Entfernung, in welcher dieselben erkannt wurden, ward an einer mit Kreide auf den Fussboden gezeichneten in ganze und halbe Meter eingeteilten Skala abgelesen.

Im ganzen gelangten so 421 Gymnasiasten mit 842 Augen zur Untersuchung. Von letzteren waren 408 oder 48·45 Prozent emmetropisch, 343 oder 40·74 Prozent myopisch, 83 oder 9·86 Prozent hypermetropisch und 8 oder 0·95 Prozent astigmatisch. Bei den astigmatischen Augen fand sich 5 mal zusammengesetzter hypermetropischer, 3 mal einfacher myopischer Astigmatismus.

Die mittlere Sehschärfe der 408 emmetropischen Augen betrug 1·25, indem die *Snellen*schen Probehaken, welche auf 6·5 m gesehen werden sollen, durchschnittlich auf 8·144 m erkannt wurden. Geringer war die Sehkraft der 343 myopischen Augen, nämlich $\frac{6 \cdot 866}{6 \cdot 5}$ oder 1·05, noch geringer diejenige der 83 hypermetropischen, nämlich $\frac{5 \cdot 316}{6 \cdot 5} = 0 \cdot 82$. Die 8 astigmatischen Augen lasen die *Snellen*schen Haken statt auf 6·5 durchschnittlich bloss auf 1·656 m, so dass sie eine Sehschärfe von nur $\frac{1}{4}$ der normalen hatten.

Auch die Unterschiede in dem Sehvermögen des rechten und linken Auges fanden Berücksichtigung. Als mittlere Sehschärfe der 210 rechten emmetropischen Augen ergab sich $\frac{7 \cdot 985}{6 \cdot 5} = 1 \cdot 23$, als diejenige der 198 linken emmetropischen Augen $\frac{8 \cdot 351}{6 \cdot 5} = 1 \cdot 29$. Die 170 rechten myopischen Augen hatten eine durchschnittliche Sehschärfe von $\frac{6 \cdot 719}{6 \cdot 5} = 1 \cdot 03$, die 173 linken myopischen Augen eine solche von $\frac{6 \cdot 982}{6 \cdot 5} = 1 \cdot 07$. Die Sehschärfe der 38 rechten hypermetropischen Augen betrug im Mittel $\frac{5 \cdot 412}{6 \cdot 5} = 0 \cdot 832$, die der 45 linken $\frac{5 \cdot 424}{6 \cdot 5} = 0 \cdot 835$. Endlich fand ich bei den 4 rechten astigmatischen Augen im Durchschnitt eine Sehschärfe von $\frac{1 \cdot 25}{6 \cdot 5} = 0 \cdot 19$, bei den 4 linken astigmatischen Augen eine solche von $\frac{2 \cdot 062}{6 \cdot 5} = 0 \cdot 32$.

Was die Sehschärfe bei den verschiedenen Graden der Myopie anbetrifft, so betrug dieselbe durchschnittlich

bei den	207	Augen	mit	einer	Myopie	von	0·5	bis	1·25	D.	1·13
„ „	64	„	„	„	„	„	1·5	„	2·75	„	0·97
„ „	46	„	„	„	„	„	3·0	„	3·5	„	0·93
„ „	13	„	„	„	„	„	4·0	„	4·5	„	0·95
„ „	9	„	„	„	„	„	5·0	„	6·0	„	0·58
„ „	7	„	„	„	„	„	7·0	„	7·0	„	0·67

Aehnlich ergab sich als mittlere Sehschärfe

bei den	73	Augen	mit	einer	Hypermetropie	von	0·5	bis	1·25	D.	0·90
„ „	9	„	„	„	„	„	1·5	„	2·75	„	0·33
„ dem	1	Auge	„	„	„	„	3·0	„	3·5	„	0·31

Es wurde ferner die Frage aufgeworfen, ob erblich belastete oder nicht belastete Myopen besser sehen. Dabei fand sich, dass die 232 nicht belasteten myopischen Augen eine durchschnittliche Sehschärfe von 1·08 hatten, die 111 belasteten eine solche von 1·01. Von den 111 belasteten myopischen Augen sahen am schlechtesten die 10, bei denen beide Eltern kurzsichtig waren: V = 0·79; dann folgten die 81, bei denen allein der Vater myopisch war: V = 1·02; am schärfsten sahen die 20, bei denen ausschliesslich die Mutter an Myopie litt: V = 1·09.

Wie die belasteten Myopen bezüglich des Sehvermögens ungünstiger als die nicht belasteten gestellt waren, so die absoluten Hypermetropen weniger günstig als die fakultativen. Die 14 absolut hypermetropischen Augen wiesen nämlich eine mittlere Sehschärfe von 0·71 auf, die 69 fakultativ hypermetropischen eine solche von 0·86.

Bei der Bestimmung des Einflusses der Lebensjahre auf die Sehschärfe der Emmetropen wurde konstatirt, dass dieselbe im Durchschnitt betrug

bei den	41	emmetropischen	Augen	9jähriger		0·84
„ „	54	„	„	10	„	1·15
„ „	45	„	„	11	„	1·15
„ „	72	„	„	12	„	1·35
„ „	47	„	„	13	„	1·24
„ „	43	„	„	14	„	1·37
„ „	34	„	„	15	„	1·28
„ „	28	„	„	16	„	1·48
„ „	17	„	„	17	„	1·56
„ „	9	„	„	18	„	1·40
„ „	14	„	„	19	„	1·40
„ „	4	„	„	20	„	1·15

Ueber die Einwirkung der Lebensjahre auf die Sehkraft der Myopen gibt die folgende Tabelle Aufschluss. Als mittlere Sehschärfe wurde berechnet

bei den	8	myopischen	Augen	9jähriger		1·18
„ „	36	„	„	10	„	1·05
„ „	30	„	„	11	„	0·98
„ „	27	„	„	12	„	1·28
„ „	32	„	„	13	„	0·94
„ „	37	„	„	14	„	1·13
„ „	47	„	„	15	„	1·10
„ „	39	„	„	16	„	1·11
„ „	39	„	„	17	„	0·94
„ „	19	„	„	18	„	0·88
„ „	14	„	„	19	„	1·19
„ „	9	„	„	20	„	0·98
„ „	4	„	„	21	„	1·11
„ „	2	„	„	22	„	0·54

Auch bei den Hypermetropen machte sich der Einfluss der Lebensjahre auf die Sehschärfe geltend. Dieselbe betrug nämlich

bei den	21	hypermetropischen	Augen	9jähriger		0·73
„ „	18	„	„	10	„	0·94
„ „	11	„	„	11	„	0·94
„ „	5	„	„	12	„	0·95
„ „	4	„	„	13	„	0·48
„ „	8	„	„	14	„	0·72
„ „	4	„	„	15	„	0·86
„ „	7	„	„	16	„	1·15
„ „	2	„	„	17	„	0·51
„ „	2	„	„	18	„	0·35
„ „	0	„	„	19	„	—
„ dem	1	„	Auge eines	20jährigen		0·61

Nicht viel anders als die Lebensjahre wirkten die Schuljahre auf das Sehvermögen bei den verschiedenen Brechzuständen ein. Als durchschnittliche Sehschärfe ergab sich nämlich

für die	2	emmetropischen	Augen	der Schüler	mit	2 Schuljahren	0·81
„	42	„	„	„	3	„	0·94
„	40	„	„	„	4	„	1·12
„	63	„	„	„	5	„	1·16
„	58	„	„	„	6	„	1·24
„	46	„	„	„	7	„	1·36
„	50	„	„	„	8	„	1·29
„	33	„	„	„	9	„	1·36
„	34	„	„	„	10	„	1·39
„	17	„	„	„	11	„	1·47
„	12	„	„	„	12	„	1·54
„	7	„	„	„	13	„	1·41
„	2	„	„	„	14	„	1·23
„	2	„	„	„	15	„	1·11

Was den Einfluss der Schuljahre auf die Sehschärfe der Myopen betrifft, so wurde festgestellt, dass dieselbe im Mittel betrug

bei den	8	myopischen	Augen	der Schüler	mit	3 Schuljahren	1·06
„	29	„	„	„	4	„	1·04
„	33	„	„	„	5	„	1·09
„	38	„	„	„	6	„	1·16
„	31	„	„	„	7	„	1·52
„	33	„	„	„	8	„	1·07
„	44	„	„	„	9	„	1·17
„	47	„	„	„	10	„	1·03
„	30	„	„	„	11	„	0·93
„	24	„	„	„	12	„	1·06
„	14	„	„	„	13	„	0·93
„	10	„	„	„	14	„	1·02
„	0	„	„	„	15	„	—
„	2	„	„	„	16	„	0·54

Endlich gestaltete sich die Sehkraft der Hypermetropen nach den Schuljahren folgendermassen. Es hatten eine durchschnittliche Sehschärfe

die	20	hypermetropischen	Augen der	Schüler mit	3	Schuljahren von	0·77
„	13	„	„	„	4	„	0·92
„	16	„	„	„	5	„	1·00
„	2	„	„	„	6	„	0·77
„	9	„	„	„	7	„	0·84
„	7	„	„	„	8	„	0·50
„	3	„	„	„	9	„	0·79
„	5	„	„	„	10	„	0·75
„	5	„	„	„	11	„	1·27
„	0	„	„	„	12	„	—
„	3	„	„	„	13	„	0·43

Ueberblicken wir die gewonnenen Resultate und ziehen die praktischen Konsequenzen für das Schulleben aus denselben, so sind folgende Punkte hervorzuheben.

Die grösste Sehschärfe besassen die emmetropischen Augen, eine geringere die myopischen, eine noch geringere die hypermetropischen und die geringste die astigmatischen. Es ist daher wünschenswert, dass möglichst wenige Schüleraugen auf der frühsten Entwickelungsstufe, derjenigen der Hypermetropie, stehen bleiben, dass sich vielmehr eine möglichst grosse Zahl zu der zweiten Stufe, derjenigen der Emmetropie, weiter bilde. Haben doch die Emmetropen neben dem Vorzug der stärkeren Sehkraft zugleich denjenigen, dass die Sehschärfe bei ihnen mit den Lebens- und Schuljahren zunimmt, was bei den Hypermetropen und Myopen nicht der Fall ist. Je mehr also das Wachstum der hypermetropischen Augen in die Länge zur Emmetropie hin erfolgt, desto besser für sie. Denn wie die absoluten Hypermetropen schlechter als die fakultativen sehen, so nimmt auch die Sehschärfe um so mehr ab, je höher der Grad der Hypermetropie ist.

Andererseits darf aber die Entwickelung der Schüleraugen nicht über die Emmetropie hinaus bis zur Myopie fortschreiten, da wir sehr wesentliche Nachteile der letzteren kennen lernten. Denn die myopischen Gymnasiasten sahen nicht nur überhaupt schlechter als die emmetropischen, sondern ihre Sehschärfe sank auch um so mehr, je hochgradiger ihre Kurzsichtigkeit war. Ja sie bilden selbst eine gewisse Gefahr für ihre dereinstige Nachkommenschaft, da myopische Kinder mit Belastung eine geringere Sehschärfe als solche ohne Belastung besitzen. Dass von den belasteten myopischen Schülern diejenigen, deren beide Eltern kurzsichtig waren, am wenigsten gut sahen, ist leicht zu verstehen. Die geringere Sehschärfe der allein von väterlicher Seite belasteten in Vergleich zu den ausschliesslich durch die Mutter belasteten dürfte sich daraus erklären, dass die Väter von Gymnasiasten, weil vielfach Gelehrte, im allgemeinen hochgradiger kurzsichtig als die Mütter sind.

Hervorgehoben zu werden verdient noch die interessante Thatsache, dass sowohl bei den Emmetropen, wie bei den Myopen, Hypermetropen und Astigmatikern durchschnittlich das rechte Auge das weniger

sehscharfe war. Dieser Unterschied zwischen beiden Augen machte sich, abgesehen von den Astigmatikern, am meisten bei den Emmetropen bemerkbar. Den Grund für die verringerte Sehschärfe des rechten Auges sehen wir darin, dass dasselbe in der Regel den zu betrachtenden Gegenständen mehr als das linke zugekehrt und demnach auch zu stärkerer Accommodationsanstrengung gezwungen wird. Die grössere Annäherung des rechten Auges an die Objekte aber erfolgt einesteils, weil die Schüler fast ausnahmslos rechtshändig sind und daher fast alles von rechts her den Augen nähern, andernteils weil die meisten in der Schule gelehrt worden sind, beim Schreiben das Heft rechts von der Körpermitte zu legen. In Uebereinstimmung hiermit hat denn auch Dr. *Schubert* durch eine umfassende Statistik festgestellt, dass bei Anisometropen das rechte Auge im allgemeinen das stärker brechende ist.

Wollen wir also der Schuljugend eine gute Sehschärfe auf beiden Augen erhalten, so werden wir sowohl die Myopie durch die bekannten, hier nicht zu wiederholenden Mittel, wie die von allen Hygienikern verwortene Rechtslage des Heftes zu bekämpfen haben

On the Importance of Detecting and Treating Defects of Vision and of Hearing in Board School Children.

BY

ADOLPH BRONNER, M.D., Surgeon to Bradford Eye and Ear Hospital.

In bringing this subject before you, I do not intend to trouble you with any long statistics or researches of my own, but would like to treat the subject from a purely practical point of view.

We all of us know how frequently defects of vision and hearing are met with in children. Cohn, of Breslau, Priestley Smith, and others have shown that between 16 and 30 per cent. of school children have defective vision. Bezold, of Munich, examined nearly 2,000 children and found impaired hearing in about 26 per cent.

There is another very common and important affection which is in intimate connexion with diseases of the ear, I refer to the so-called post-nasal growths. This is an enlargement of the glandular tissue of the back of the nose, which prevents the free passage of air through the nostrils, and also often causes inflammation of the middle ear. The children cannot breathe through the nose, and therefore always keep the mouth open and snore at night. The growths thus prevent normal development of the chest and lungs, and they also, as Professor Guye, W. Hill, Scanes Spicer, and others have pointed out, affect the mental development of children. Meyer, of Copenhagen, shows that from two to seven per cent. of children suffer from post-nasal growths, and that over 80 per cent. of children who have these growths are also deaf.

Statistics thus show how very common defects of vision and of hearing are in children. How many of these cases are attended to in time? Very few indeed! Even in adults of the educated classes we not infrequently meet with patients who have not been able to see or hear well for some months, or even years, and who have never before sought medical advice. How much more are these cases neglected in the children of the uneducated classes? In these cases it is the duty of the master at school to interfere and to see that the children are attended to. At present a child who cannot see or hear well, and who therefore does not get on well at school, is looked upon as stupid and lazy, and treated accordingly. Many a brilliant career has been spoilt, and many a child condemned to a life of misery and toil, because some defect of vision and hearing has been neglected. But not only that, we often meet with neglected cases which have become a life-long burden to their relatives or to the community at large. Many cases of neglected discharge from the ear end in inflammation of the brain and death. Neglected cases of post-nasal growths lead to deafness and imperfect development of the body and mind.

The teachers of our board schools are at present perfectly incompetent to deal with these cases. They have no means of testing the vision or hearing of the children, and even if they had, they have no orders or authority to interfere.

What I would suggest is, that certain instructions be given to the teachers, so that they may, in a rough manner at least, be able to judge if a child is defective in sight or in hearing. The case should be reported to the head-master, who would then inform the parents of the child, and request them to have the child examined by their family doctor, or, if they are poor people, at some hospital.

All children should be reported whose vision in either eye is less than $\frac{6}{18}$, and who cannot read Jaeger 2 at from 50 to 10 c.m. Also all children who cannot hear a pocket-watch at about 15″, and also those who cannot breathe through the nose, and who consequently keep the mouth open and snore at night. No child ought to be allowed to attend school if and as long as there is any discharge from the ear or ears.

That these suggestions are imperfect and open to grave objections, I know perfectly well. Still I think they are a step in the right direction. They may be of some benefit to the children till we succeed in having medical men appointed to examine the children of all public schools, and I sincerely hope and trust that the time may not be far distant when every large town will have a medical inspector whose sole duty it shall be to watch over the health and well-being of the children of the poor, and also of the rich. For on their health and welfare rests not only the happiness of our homes, but also the greatness and prosperity of our nation.

Nécessité des Études anthropologiques et anthropométriques dans la première Enfance, la Jeunesse, la Vie de l'École et l'Âge adulte.

PAR

le Dr. M. DE TOLOSA-LATOUR, Médecin en Chef de l'Asile du Sacré-Cœur de Jésus à Madrid.

A propos de l'hygiène scolaire, les membres organisateurs de ce Congrès ont posé, dans la quatrième Section, paragraphe IV, une série de questions sur le développement intellectuel et physique de l'enfance. Depuis longtemps déjà, ce problême m'a profondément préoccupé. En 1879, dans mes études sur l'hygiène et l'éducation de l'enfant, au Congrès de la Protection de l'Enfance, tenu à Paris en 1883, au Congrès gynécologique et pédiatrique de Madrid, en 1888, enfin au Congrès de Protection de l'Enfance, tenu à Anvers, en 1890, j'ai fait ressortir l'importance et la nécessité d'étudier ces problèmes et j'ai soutenu, à propos du placement dans les familles, que tout enfant devait préalablement subir une période d'observation et être soumis à des mensurations régulières; qu'il fallait recueillir avec soin tous les faits susceptibles de mettre en lumière ses aptitudes. Un vœu a été formulé, au sujet des enfants assistés, ayant pour but de pratiquer un examen méthodique de ceux-ci.

L'anthropologie est une branche nouvelle des sciences médicales; sa sœur cadette est l'anthropométrie, et je suis, tout en reconnaissant l'incontestable utilité de la première, absolument convaincu que la seconde est appelée à rendre de grands services, dans la solution des problèmes que cherche à résoudre l'hygiène; je veux parler de l'élevage du nourrisson, de l'éducation de l'enfant et du développement de l'homme.

C'est pour cela que je viens de nouveau appeler votre attention sur l'importance de cette méthode que je ne cesserai de propager avec l'énergie de la foi, dans une idée humanitaire.

Les limites qui me sont assignées par vos réglements ne me permettent malheureusement pas de m'étendre, autant que je le voudrais, sur cette question si digne d'intérêt; aussi, ne ferai je que l'esquisser, me réservant de la traiter plus à fond ultérieurement.

Examinons l'enfant dans trois conditions diverses :—

A.—Dans sa famille;
B.—Dans les écoles;
C.—Dans les asiles.

A. *Dans sa famille.*—Il serait à souhaiter que, dès naissance, l'enfant fût pesé et mesuré, d'après des indications précises; ces mensurations se renouveleraient tous les six mois.

Dans chaque mairie existerait un régistre à souches, sur lequel seraient inscrits les résultats et un bulletin serait remis chaque fois aux parents, avec prière de le conserver.

a. Cette mesure n'a rien de vexatoire et serait le corollaire de la loi qui exige, en tous pays civilisés (en Espagne, Registro civil, Juzgado municipal), la présentation du nouveau-né à l'officier civil. Du reste, certains parents s'y prêteraient volontier; en effet, vous avez vu se généraliser rapidement l'usage du pèse-bébés et beaucoup de pères sont heureux de noter sommairement, le long d'une planche ou d'un mur, la croissance de leurs enfants. J'ajouterai que l'on cherche à rendre obligatoire la vaccination qui est un des plus sérieux prophylactiques, ne s'addressant malheureusement qu'à une seule maladie. Pour triompher des résistances, il suffirait d'exiger, au moment de l'entrée dans les écoles, la présentation des bulletins sanitaires, comme on exige un certificat de vaccination.

Je noterai, chemin faisant que ce système a été imposé à l'administration pénitenciaire qui semble même s'y conformer trop rigoureusement, en l'appliquant aux prévenus qui pourtant sont réputés innocents, jusqu'au moment de leur condamnation, ce qui est bien autrement vexatoire. Et ce que la société fait, dans un but défensif, contre les criminels, ne doit-elle pas le faire avec plus d'intérêt en vue de l'hygiène?

Autant que possible, on répondra dans les familles des bulletins individuels sur lesquels le médecin particulier, ou un médecin délégué, pour les familles pauvres, inscrira les mensurations pratiquées, relatant avec soin les antécédents héréditaires, les remarques sur le tempérament de l'enfant et les cas pathologiques susceptibles de se produire ou déjà produits.

B. *Dans les écoles.*—L'adoption de cette pratique sera facile à provoquer. Tous les six mois, aura lieu un examen physique, de même que se pratique un examen intellectuel, à la fin de chaque année, et, concurremment avec le bulletin des progrès accomplis, le chef de l'établissement fera parvenir aux parents un bulletin du développement physique.

Dans l'administration pénitenciaire, ce sont des gardiens qui sont chargés de pratiquer les mensurations. Les instituteurs, toujours si dévoués, ne manqueraient pas d'accomplir, avec autant de zèle et d'intelligence la nouvelle tâche qui leur serait dévolue.

Quant à ce qui est du compte-rendu de l'état pathologique et des antécédents héréditaires, le soin en serait confié à un médecin inspecteur des écoles qui le ferait parvenir lui-même aux parents.

Cette mesure est aussi d'un grand intérêt au point de vue de la prophylaxie des maladies contagieuses. Après sa guérison, aucun enfant ne serait admis de nouveau à l'école, sans la présentation d'un certificat sanitaire. La maladie serait signalée dans le bulletin que la famille doit garder.

Ainsi seraient vaincues bien des susceptibilités, bien des répugnances de la part des parents qui tous ont confiance dans la discrétion professionelle du praticien. En outre, ceux d'entre eux qui, de parti pris,

ou par négligence auraient pu soustraire leurs enfants à ces examens périodiques, durant la première enfance, ne pourront plus s'y dérober, alors qu'ils voudront leur faire donner le pain de l'intelligence, à l'école ou au pensionnat.

Du reste, Messieurs, dans certains pays, le législateur a décrété l'instruction obligatoire. Ne pourrait-il pas étendre cette loi, en voulant que, par tous les moyens possibles, on favorisât le développement physique des élèves par ce contrôle régulier de leur santé? C'est, d'ailleurs, à ce but que l'on tend par la création d'écoles et de sociétés de gymnastique. Je soutiendrai toujours, qu'avec des examens méthodiques, on obligerait les familles à prendre plus de soucis de leurs enfants, que l'on reconnaîtrait souvent ainsi des indices qui, en appelant l'attention du praticien, lui permettront parfois d'enrayer le dévelloppement d'un état diathésique encore latent et de faire ainsi une bonne et saine prophylaxie. Et qu'à ce sujet il me soit permis de vous faire remarquer, ce que vous savez tous, qu'une croissance prématurée est souvent l'indice de nervosisme ou de tuberculose, une croissance tardive celui du rachitisme.

C. *Dans les asiles*, on rencontrera encore moins de difficultés; car on a affaire à des enfants abandonnés ou orphelins et il n'y aura pas à lutter contre un parti pris.

C'est dans un asile d'orphelins que j'ai commencé à pratiquer mes mensurations; mais ce travail est encore trop récent pour que je puisse formuler des conclusions qui s'imposeront dans quelques années. Il me suffit de vous dire ici que je suis heureux des résultats obtenus et vous trouverez, à la fin de ce travail, quelques tableaux qui pourront diriger dans leurs recherches ceux d'entre vous qui voudront bien m'aider de leur concours.

Laissez moi rapidement maintenant vous indiquer les avantages que peut présenter cette méthode soigneusement suivie.

Dans toutes les familles, on conservera les bulletins de santé, de même que beaucoup de parents conservent, avec raison, les prescriptions du médecin; et, lorsque pour des motifs quelconques, il y aura lieu de consulter un médecin nouveau, sa tâche sera plus facile, si on lui présente des observations à l'aide desquelles il pourra reconstituer l'histoire physique de l'enfant, de même qu'il lit celle d'une pneumonie sur une courbe thermométrique, quand il s'agit d'un malade.

Le médecin des écoles verra aussi s'aplanir devant lui bien des difficultés et il pourra, à l'aide des registres établis, fournir à la science de précieux documents pour l'étude de la physiologie et de la pathologie.

Dans les asiles, (ici, Messieurs, je ne fais que transcrire les paroles prononcées par moi, en 1888, au Congrès gynécologique et pédiatrique de Madrid), "on formera une véritable histoire organique du pauvre " abandonné, ce qui permettra de lui remettre plus tard l'étude complète " de son développement, durant son enfance, des maladies qu'il a subies " et l'indication des mesures d'hygiène qu'il lui convient d'observer plus

" particulièrement. Ainsi le malheureux orphelin trouvera dans la " société une mère pleine de prévoyance et d'affection, dont le souvenir " chéri le poussera dans la voie du bien, au lieu d'une marâtre qui lui " jettera à la face l'abandon dont il a été victime et la bâtardise de son " origine."

Par ce moyen aussi, nous ne rencontrerons plus de ces gens qui, au cours d'une maladie, ne peuvent fournir aucun renseignement sur leur passé pathologique. Et pourtant, Messieurs, que de notions précieuses apporte au diagnostic, au pronostic et au traitement, l'histoire des maladies si nombreuses de l'enfance !

Dans le domaine médico-légal, la tâche du praticien appelé à se prononcer sur des questions si graves de responsabilité sera rendue plus facile, il pourra, d'un coup d'œil, reconnaître si les tendances vicieuses qu'a présentées le sujet durant son enfance, n'ont pas pu, en le déséquilibrant, faire de lui un inconscient ; et ainsi la société évitera de frapper un innocent. Vous aurez de cette façon, Messieurs, comme le réclame votre programme, un moyen graphique, (si je puis m'exprimer ainsi), de constater périodiquement le *degré moyen normal dans le développement intellectuel et corporel ; quant aux causes qui le retardent*, vous pourrez souvent les constater par une étude approfondie des documents qui vous seront présentés ; *les tendances héréditaires* vous seront nettement exposées par les bulletins que vous présenteront les parents et, dans les asiles, par l'examen d'un régistre spécial, comme celui que j'ai fait établir à Madrid, à l'asile que je dirige au point de vue sanitaire et dont je vous présente à la fin de ce travail le spécimen de l'un des feuillets.

Les conditions sanitaires du domicile et de l'école seront également fournies par l'étude comparative de bulletins provenant de différents quartiers, de différentes rues. On verra facilement si, dans telle contrée, telle ville, tel quartier, ou même telle école d'un même quartier, certaines influences ont agi sur le développement des forces tant psychiques que corporelles. En comparant encore dans l'ordre chronologique, vous constaterez que telle ou telle *épidémie* a joué un rôle important dans ce développement. Ne serait-il pas curieux de constater aujourd'hui quel a été, dans ce sens, le rôle qu'a pu jouer ou que jouera sur nos jeunes générations les épidémies d'influenza ou de diphtérie qui font et dont les conséquences font aussi, tant de victimes ? Enfin, vous remarquerez dans les ateliers, dans les industries diverses, quelles sont les professions qui peuvent favoriser ou retarder ce développement et, ainsi, vous répondrez à la dernière question concernant *l'hygiène personnelle* et, j'ajouterai professionnelle.

À ce sujet, dans un travail couronné par la Société espagnole d'Hygiène, *Sur le Travail de la Seconde Enfance*, j'ai indiqué la nécessité des livrets sanitaires non-seulement dans les familles, mais encore dans les ateliers divers.

Tels sont, Messieurs, esquissés à grand traits, les considérations que j'ai l'honneur de soumettre au Congrès. Je suis certain de trouver

parmi vous des confrères dévoués qui voudront bien m'aider de leurs lumières et de leur concours dans une tâche à laquelle je consacrerai toutes mes forces; et je me féliciterai si j'ai pu faire passer dans vos esprits une conviction inébranlable.

En conséquence, je vous prie de vouloir bien émettre le vœu suivant :—

Le Congrès émet le vœu qu'une propagande active se fasse de toutes parts pour que des études anthropologiques et anthropométriques soient pratiquées périodiquement par les médecins au sein des familles; pour que dans chaque école, asile ou atelier on établisse un régistre spécial où en même temps que les progrès intellectuels, soient consignés les résultats des mensurations, les antécédents héréditaires et l'histoire pathologique des enfants. Les divers États doivent, dans leur législation sanitaire respective, adopter les dispositions nécessaires à ce but, afin que chacun puisse posséder une histoire complète de sa vie physique.

APPENDIX.

TRADUCTION du chapître III du règlement Sanitaire de l'Asile du Sacré-Cœur de Jésus à Madrid, relativement au "Livre Sanitaire."

ART. 11. Le but du livre sanitaire est de conserver d'une façon co-ordonnée toutes les particularités intéresant la santé de chaque élève.

ART. 12. On y consignera les faits suivants :—

1° Nom de l'élève, numéro d'ordre, lieu de naissance, âge, antécédents de famille, maladies souffertes avant l'admission à l'asile ;

2° Filiation à l'entrée ;

3° Examen annuel du développement ;

4° Histoire pathologique résumant les affections éprouvées pendant le séjour à l'asile ;

5° Observations sur l'avenir physique.

ART. 13. En même temps que la filiation, on inscrira à l'entrée les faits suivants :—Poids ; Taille ; Force ; Acuité visuelle ; Capacité pulmonaire ; Périmètre thoracique ; Forme, diamètres de la tête et toute particularité digne d'être signalée au point de vue anthropométrique.

ART. 14. Chaque année on pratiquera ces examens pour constater le développement des enfants.

MENSURATIONS ANTHROPOMÉTRIQUES (JUIN 1891).

Tableau des maximum, minimum, moyennes.

Nomenclature des Mensurations.		1ère Série de 5 à 6 ans, 1 élève.	2e Série de 6 à 7 ans, 4 élèves.	3e Série de 7 à 8 ans, 13 élèves.	4e Série de 8 à 9 ans, 15 élèves.	5e Série de 9 à 10 ans, 15 élèves.	6e Série de 10 à 11 ans, 33 élèves.	7e Série de 11 à 12 ans, 25 élèves.	8e Série de 12 à 13 ans, 18 élèves.	9e Série de 13 à 14 ans, 21 élèves.	10e Série de 14 à 15 ans, 10 élèves.	11e Série de 15 à 16 ans, 8 élèves.	12e Série de 16 à 17 ans, 9 élèves.	13e Série de 17 à 18 ans, 2 élèves.
Poids	max.	17·800	19·300	23·500	24·000	26·700	31·500	35·300	48·000	49·400	42·000	53·000	51·400	55·900
	min.	17·800	17·509	15·300	18·000	14·800	18·000	22·200	25·000	25·600	29·300	28·400	40·000	46·000
	moy.	17·800	18·325	18·850	20·600	22·340	25·480	29·352	30·900	32·652	37·100	42·600	47·550	50·950
Taille	max.	1·098	1·140	1·222	1·240	1·312	1·365	1·430	1·520	1·580	1·490	1·575	1·680	1·620
	min.	1·098	1·052	1·030	1·080	1·050	1·135	1·178	1·190	1·235	1·320	1·257	1·552	1·433
	moy.	1·098	1·090	1·129	1·191	1·210	1·263	1·307	1·351	1·403	1·425	1·492	1·602	1·526
Périmètre thoracique	max.	51·	57·	59·	62·	63·5	65·5	68·5	79·5	77·	77·	83·	85·	86·
	min.	51·	53·	48·	52·	49·	51·	57·	59·	61·	64·	63·	79·	82·
	moy.	51·	55·4	54·23	56·7	53·4	60·	63·24	65·7	67·70	70·08	74·8	81·03	84·
Capacité pulmonaire	max.	0·80	1·10	1·23	1·60	1 78	1·94	2·13	3·27	2·50	2·59	3·13	3·77	3·57
	min.	0·80	0·75	0·45	1·00	0·49	0·80	1·10	1·40	1·28	1·20	1·82	2·60	3·55
	moy.	0·80	0·90	0·93	1·25	1·24	1·56	1·69	2·16	1·45	2·16	2·67	3·04	3·56
Développement des bras	max.	1·105	1·12	1·250	1·260	1·295	1·400	1·445	1·530	1·630	1·490	1·630	1·660	1·620
	min.	1·105	1·08	1·055	1·094	1·020	1·140	1·190	1·200	1·230	1·354	1·280	1·540	1·460
	moy.	1·105	1·09	1·130	1·174	1·200	1·259	1·320	1·347	1·409	1·434	1·520	1·602	1·540

Mensurations anthropométriques (Juin 1891)—*continuées.*

Nomenclature des Mensurations.		1ère Série de 5 à 6 ans, 1 élève.	2e Série de 6 à 7 ans, 4 élèves.	3e Série de 7 à 8 ans. 13 élèves.	4e Série de 8 à 9 ans, 13 élèves.	5e Série de 9 à 10 ans, 15 élèves.	6e Série de 10 à 11 ans, 33 élèves.	7e Série de 11 à 12 ans, 25 élèves.	8e Série de 12 à 13 ans, 18 élèves.	9e Série de 13 à 14 ans, 21 élèves.	10e Série de 14 à 15 ans, 10 élèves.	11e Série de 15 à 16 ans, 8 élèves.	12e Série de 16 à 17 ans, 9 élèves.	13e Série de 17 à 18 ans, 2 élèves.
Longueur	du bras	max.	37·5	36·4	41·	41·8	43·2	46·	47·5	51·	55·	52·	55·5	59·	55·
		min.	37·5	35·2	32·2	35·5	35·	36·	39·5	40·	41·	45·5	41·	52·5	50·
		moy.	37·5	35·5	36·9	38·	40·2	41·8	42·4	42·8	48·9	47·2	51·17	56·	52·5
	de la main	max.	12·2	13·	13·	15·6	15·	17·	16·8	18·5	19·	18·2	18·2	20·	19·
		min.	12·2	12·	11·5	11·2	12·	12·5	13·	14·	14·5	15·	16·	17·5	16·
		moy.	12·2	12·5	12·44	12·90	13·6	14·4	14·8	15·6	16·2	16·59	17·8	18·	18·5
	du pied	max.	19·	19·	20·7	21·	21·	25·5	24·	27·	28·	26·	27·	28·	26·
		min.	19·	17·5	15·	17·8	16·5	19·	19·3	20·	21·	23·	22·	25·5	24·
		moy.	19·	18·17	18·5	19·	20·	21·10	22·20	22·38	23·08	24·05	25·4	26·9	25·
Diamètres craniens	bi-pariétal	max.	26·	28·	28·8	29·	29·	30·2	31·	29·5	30·	31·	32·	31·	30·
		min.	26·	27·	26·	26·2	27·	26·	27·	27·	27·	27·	29·	29·	30·
		moy.	26·	27·57	27·7	27·9	28·2	28·	27·6	28·2	26·8	28·9	29·1	29·8	30·
	occipito-frontal	max.	35·	36·3	38·2	37·5	37·2	40·1	39·	40·	37·5	38·5	38·	39·5	38·
		min.	35·	35·3	33·5	34·2	33·4	35·	34·	35·	33·	35·	34·	36·	36·
		moy.	35·	36·	35·4	35·9	35·28	36·	36·	36·	36·1	36·5	37·	37·4	37·
	circonférenciel	max.	46·8	48·	48·	50·	50·	50·2	51·	51·	54·	53·	54·	54·	52·
		min.	46·8	46·5	43·5	45·5	44·	46·	45·	46·	47·	48·	46·	49·	52·
		moy.	46·8	47·	45·9	46·9	47·5	48·1	49·5	48·7	49·8	49·73	51·	51·10	52·

Mensurations.

Nomenclature des mensurations.		1ère Série de 5 à 6 ans, 1 élève.	2e Série de 6 à 7 ans, 4 élèves.	3e Série de 7 à 8 ans, 13 élèves.	4e Série de 8 à 9 ans, 13 élèves.	5e Série de 9 à 10 ans, 15 élèves.	6e Série de 10 à 11 ans, 33 élèves.	7e Série de 11 à 12 ans, 25 élèves.	8e Série de 12 à 13 ans, 18 élèves.	9e Série de 13 à 14 ans, 21 élèves.	10e Série de 14 à 15 ans, 10 élèves.	11e Série de 15 à 16 ans, 8 élèves.	12e Série de 16 à 17 ans, 9 élèves.	13e Série de 17 à 18 ans, 2 élèves.
Force au dynamomètre. main gauche	max.	3°	7°	8°	15°	12°	19°	20°	29°	29°	30°	38°	37°	38°
	min.	3°	4°	2°	5°	5°	6°	9°	10°	14°	12°	19°	28°	29°
	moy.	3°	5°	5·5	8°	8·5	10°	13·16	15·6	20·09	22·89	27·5	33·1	33·5
main droite	max.	3°	6°	8°	14°	12°	17°	20°	24°	27°	31°	34°	40°	36°
	min.	3°	3°	1°	5°	4°	5°	8°	9°	12°	14°	13°	25°	33°
	moy.	3°	4·2	5°	6·5	7·8	8·9	11·5	14·2	17°	20°	24·33	30·02	34·5

Tableau des Moyennes.

Poids	17·800	18·325	18·850	20·600	22·340	25·480	29·352	30·900	32·652	37·100	42·600	47·550	50·950
Taille	1·098	1·090	1·129	1·191	1·210	1·263	1·307	1·351	1·403	1·425	1·492	1·602	1·526
Périmètre thoracique	51°	55·4	54·23	56·7	58·4	60°	60·24	65·7	67·70	70·08	74·8	81·03	84°
Capacité pulmonaire	0·80	0·90	0·93	1·25	1·24	1·36	1·69	2·16	1·45	2·16	2·67	3·04	3·55
Développement des bras	1·105	1·09	1·130	1·174	1·200	1·259	1·320	1·347	1·409	1·434	1·520	1·602	1·540
Longueur du bras	37·5	35·5	36·9	38°	40·2	41·8	42·4	42·8	48·9	47·2	51·17	56°	52·5
„ de la main	12·2	12·5	12·44	12·90	13·6	14·4	14·8	15·6	16·2	16·50	17·8	18°	18°
„ du pied	19°	18·17	18·5	10°	20°	21·1	22·20	22·38	23·08	24·05	25·4	26·9	25°
Diamètre bi-pariétal	26°	27·57	27·7	27·9	28·2	28·0	28°	27·6	28·2	26·8	28·90	29·8	30°
„ occipito-frontal	35°	36°	35·4	35·9	35·28	36°	36°	36°	36·1	36·5	37°	37·4	37°
„ circonférenciel	46·8	47°	45·9	46·9	47·5	48·1	49·5	48·7	49·8	49·73	51°	51·10	52°
Force au dynamomètres main dr.	3°	5°	5·5	8°	8·5	10°	13·16	15·6	20·09	22·89	27·5	33·1	33·5
„ „ „ g.	3°	4·2	5°	6·5	7·8	8·9	11·5	14·2	17°	20°	24·33	30·02	34·5

DISCUSSION.

Dr. Gallandet (President of the National Deaf-mute College, Washington, D.C., U.S.A.), said: I have listened with the greatest pleasure to General Moberly's paper on the education of deaf-mutes. As you are probably aware, there are several matters of interest connected with the education of the deaf which may be called burning questions; and among them there is none of greater consequence than the question of method. In regard to the different ways of teaching, there have been differences of opinion that have amounted actually to a war of methods, and the views expressed by General Moberly are so entirely in accord with the best sentiment in America to-day, that I have great gratification in endorsing them. On entering the hall this morning, I received a paper which has been, I notice, generally distributed, in which the assertion is made that "the oral method of teaching the deaf succeeds with all "except those who have imperfect vision or defective intellect." No error can be greater than this, for it has been abundantly proved in America, as also in England, as stated by General Moberly, that many of the deaf do not possess that faculty, the existence of which is quite as necessary to the successful acquisition of speech, as is the musical faculty in a normal person to success in music, or the artistic faculty to success in art. *With* this faculty, a deaf child, even though born deaf, may certainly learn to speak under proper instruction; but without it, absolute failure occurs in many cases, and in many others that half-success which is often worse than failure. Now it is entirely possible, in very many of these cases, where the attainment of speech is impracticable, for the deaf-mute to secure a high degree of education under the manual method. Consequently a general system which makes a judicious combination of the two methods is beyond all question to be preferred.

I desire, then, to direct the attention of the Congress to the higher education of the deaf, and would urge that a suitable amendment be offered to the legislation recommended to Parliament by the Royal Commission, which shall authorise the extension, in certain well recommended cases of exceptional ability, of the limit of time up to which State aid may be given. For example, that five years be added to provide for this higher education, a curriculum for which could easily be arranged in some existing primary institution. This course was pursued at Washington more than 25 years ago in the institution with which I am connected; and the college for deaf-mutes in that city, handsomely sustained by the Federal Government, has carried large numbers of the deaf through an advanced course of study in the ancient and modern languages, the higher mathematics, the natural sciences, history, &c., &c., up to the point of graduation, with degrees in the arts and sciences. This, I trust, may soon be done in England. I would further express my great satisfaction with the paper on the education of the blind. Dr. Campbell, its distinguished author, and my most esteemed fellow countryman, needs no commendation from me here. You have adopted him, and his noble work in creating and establishing on enduring foundations the Royal Normal College for the Blind will be his monument.

In the views I have expressed, I take pleasure in saying I have the hearty support of my colleague in our profession, Dr. Warring Wilkinson, principal of the California Institution for the Deaf and Dumb and the Blind, who is in attendance here with me this morning. We join in

the earnest wish that the cause of the deaf and the blind, always popular in this benevolent country, may be still further advanced on the lines indicated in the able papers presented by General Moberly and Dr. Campbell.

Dr. Gutzmann (Berlin) sagte:—Meine Worte sollen sich auf den Vortrag von Herrn Moberly beziehen. In Deutschland ist bekanntlich durchweg die orale Methode des Taubstummen-Unterrichtes eingeführt. Leider hat sich in Deutschland in letzter Zeit eine Opposition gegen die orale Methode geltend gemacht. Der Hauptgrund, welchen man gegen diese Methode anführt, ist, dass die Taubstummen, welche sich der Lautsprache bedienen, bei der Unterhaltung nicht zu sich selbst, sondern nur zu Anderen sprächen, und dass infolgedessen die orale Methode widernatürlich sei. Dieser Einwand ist gänzlich unberechtigt. Die Taubstummen sprechen, wenn sie sich der Lautsprache bedienen, auch zu sich selbst, und zwar wird die Kenntniss des Gesprochenen, das Verständniss der einzelnen Laute vermittelt durch den Muskelsinn. Es ist eigenthümlich, dass die Gegner der oralen Methode diesen Punkt ganz ausser Acht gelassen haben. Dass aber die orale Methode auch bei weniger begabten Taubstummen durchgeführt werden muss, ist eine absolute Forderung der Hygiene. Es werden bekanntlich unsere Lungen besonders geübt und gekräftigt dadurch, dass wir sprechen. Von dem russischen Arzte Person wurde schon vor Jahrzehnten in einer ausführlichen Schrift dargethan, dass die in Russland in der Zeichensprache unterrichteten Taubstummen in weit grösserer Prozentzahl an Schwindsucht (Lungentuberkulose) erkrankten als die in der oralen Methode unterrichteten deutschen Taubstummen. Dies ist von allen Aerzten, die sich sonst mit der Taubstummenbildung befasst haben, wie E. Schmalz, Hartmann, H. Schmaltz, und besonders von Kussmaul als ein ausserordentlicher Vortheil der oralen Methode hervorgehoben worden. Es ist demnach schon eine Forderung der allgemeinen Hygiene, dass die taubstummen Kinder sämmtlich, auch die schwachsinnigen, in der oralen Methode unterrichtet werden.

Ein zweiter Punkt, auf den ich eingehen möchte, ist das sog. Lippen-Lesen (Lip-reading). Herr Moberly hat Folgendes gesagt:—"I have "been somewhat surprised at the capacity for reading the lips of their "teachers and school-fellows shown by many of the pupils in our classes, "but I fear very few of them are sufficiently advanced to understand "strangers and casual visitors."

Dies trifft auch für Deutschland im allgemeinen zu. Es fragt sich nur, ob diesem Uebelstand nicht abgeholfen werden kann. Die Taubstummen erlernen ihre Absehfertigkeit auf folgende Weise:—

1. Sie erlernen das Absehen der Laute zugleich mit der Lautbildung nach der Lage der Artikulationsorgane, besonders im Inneren des Mundes.
2. Sie werden beim Absehen vom Munde Anderer nach ihrem Gefühl der eigenen Sprachthätigkeit geleitet.
3. Sie erlernen das Absehen nur an dem Munde ihres Lehrers.

Dass die Absehfertigkeit der meisten Taubstummen gegenüber Fremden so gering ist, dass sie häufig genug zu der natürlichen Gebärde ihre Zuflucht nehmen müssen, liegt daran, dass ein eigentlicher Absehunterricht in Taubstummen-Anstalten nicht existirt, dass ferner die sichtbaren Zeichen der einzelnen Laute nicht genügend ausgenützt sind.

In einem demnächst erscheinenden grösseren Werke über die Störungen der Sprache werde ich eine ausführliche Anweisung veröffentlichen, in welcher Weise das Absehen vom Gesichte des Sprechenden als besonderer Gegenstand der Ueberweisung in Taubstummen-Anstalten eingeführt werden könnte. Ich will hier nur hervorheben, dass die Sprachlaute nicht nur von vorn (en face), sondern auch von der Seite (en profil) und zwar bei verdecktem Munde fast sämmtlich abgelesen werden können. (Demonstration Beispiele.) Ferner haben eine Reihe von Silben ganz besondere Bewegungen, welche beim Absehunterricht genau so eingeübt werden müssen, wie der Stenograph seine Zeichen einübt.

Mein Vater und ich haben auf diese Weise viele von Geburt Taube und später Ertaubte zum fliessenden Absehen gebracht. Ein Herr, welcher völlig taub war, war sogar im Stande im Theater vom Parquet aus das Gespräch zweier Damen in der Loge mittelst des Opernglases zu belauschen. Ich freue mich auch schon einmal öffentlich Gelegenheit gehabt zu haben, die Möglichkeit selbst bei verdecktem Munde gut abzulesen zu demonstriren, auf der I. medizinischen Klinik in Berlin von Herrn Professor Dr. Leyden.

Mr. William van Praagh (London) had listened with great pleasure to General Moberly's paper. The action of the school board in this branch of education is most commendable. Having followed the movement from its very beginning, he fully appreciated the difficulty they have had, and have, to deal with; but in his opinion those difficulties are not insurmountable. The association for the oral instruction of the deaf and dumb has supplied the board with its first teacher on the pure oral system, and has carried on a class in Bermondsey under its auspices, until in time the board resolved to adopt the oral system in all its classes, when they naturally withdrew their supervision. He hoped the time will come when the board will be able to adopt the pure oral system in all its classes. He could speak volumes on the subject-matter introduced by General Moberly. Time would only allow him to touch upon a few technical items. He maintained that all deaf children, except the weak minded, can be taught on the pure oral system, and contradicted Dr. Gallandet's objections. In America a society has been started by Dr. Graham Bell for the promotion of teaching of speech to the deaf. Lip-reading is the backbone of the pure oral system. If the child has another vehicle for conveying language to him, he will never get sufficient proficiency in lip-reading; hence systems must *not* be combined. Deaf children must be taught in their early days out of books specially written for them.

Instruction is given to the greatest advantage in day schools. He objected to the hoarding of large numbers of afflicted children in asylums. Many children in schools suffered from defective articulation, resulting in indistinct speaking. These should be collected in classes by their teachers, and should receive treatment from specialists. Every school ought to have the services of an ophthalmic surgeon to examine periodically the sight of pupils.

Dr. Campbell then proposed the following *Resolution*:—

> "That the time has arrived when the blind should have a well-graded, practicable, comprehensive course of instruction. That the training of the blind should not be conducted on a charitable basis, but should form a part of the national system of education."

This was seconded by the President; and was *carried* with the insertion of the words "deaf and dumb" after blind.

A hearty vote of thanks to the Executive of the Section, proposed by Dr. Burgerstein and seconded by Mr. M. Jackson, J.P., was carried by acclamation; and the proceedings of the Section then terminated.

INDEX.

A.

Page

with the managers of industrial schools, copy orm of - - 161
hild-labour laws. (A. .D.) - - - 57
gent desirable in tooth - - - - - 79
:bungen ueber psycho- minderwertige Kinder n. (L. Strümpell, . Koch, E. Schmidt, - - - 212
Dr.), founder of the ıd Foreign Blind Asso- - - - 233
es Orphelins considérée le vue de leur Hygiène et Morale. (Dr. sguin) - - - 175

B.

:d), remarks in discus- Can hungry and half- :children be efficiently - - - 202
ɔn L'enfant à tendances es ou placé dans un iminel - - - 175
'. Graham), remarks in on the scientific obser- d study of children in and the classes into y may be grouped - 16
tcher), The care and of epileptic, mentally l imbecile children - 203
ımendment seconded by 224
remarks in discussion ientific observation and :children in schools - 16
'Hygiène Scolaire en. c. Kuborn) - - 95
's. Annie), Can hungry f-clothed children be educated? - - 195

Page

Blind, report of the Royal Commission on, in 1889 - - 225
——, suggestions for an educational system for the - - 228
——, —— national system of training for the - - - 232
——, The education of the. (F. J. Campbell) - - - - 224
Boarding schools, hospital accommodation requisite for dealing with outbreaks of epidemic illness in large - - - - 45
Braille system of dots in forming the characters in printing and writing for the blind - - 234
Brentwood Industrial School - 152
British Dental Association investigation, principal features of the - 82
Broman (Allan), Physical exercises in elementary schools - - 114
Bronner (Adolph), On the importance of detecting and treating defects of vision and of hearing in Board School children - - 252
Brown (Dr. William), remarks in discussion on manual training in relation to health - - - 123
Burgerstein (Dr. Leo), The working curve of an hour; an experiment concerning overpressure of brain 87
—— ——, remarks in discussion on some of the laws which influence the growth of the child - 109
Burial societies in their relation to infant life insurance, Objectionable features of some. (Charles E. Paget) - - - - 67
—— ——, provisions of mutual - 69
—— ——, suggested improvements in provisions of mutual - - 69

C.

Campbell (F. J.), The education of the blind - - - - 224
Care and treatment of epileptic, mentally feeble, and imbecile children. (Dr. Fletcher Beach) 203

Page

Caries, best means of counteracting 75
——, conditions causing frequency of - - - 72
——, effects of - - - 71
——, necessity for remedial treatment of - - - 82
Chalmers (Dr.), remarks in discussion on l'Enfant Pauvre - 201
Cheadle (Dr.), remarks in discussion on physical indications of injurious schooling - - 26
Child-labour laws, American. (Dr. A. Jacobi) - - - - 57
—— ——, object of - - 65
Children, individual remedial agencies for dealing with neglected - - - - 135
—— in schools, The scientific observation of, and the classes into which they may be grouped. (Dr. Francis Warner) - - 10
—— ——, the study of - - 14
——, social remedial agencies for dealing with neglected - - 134
——, the classes or groups of, found in schools - - - 12
—— with low nutrition, table showing conditions presented by 14
Chorea in school children, detection of - - - 23
Cities, Neglected children in our towns and. (William Mitchell) 131
Connecticut, child-labour laws in - 64
Criminalité, Progrès de la Diffusion de l'Instruction publique en Belgique, au point de vue de la. (Dr. Hyac. Kuborn) - - 137
Criminality, table showing progress of from 1836–1885, and of elementary public instruction in Belgium from 1840–1880 - 143
Cunningham (Geo.), Defective personal hygiene as it affects the teeth in infancy, childhood, and school life - - - 71

D.

Davies (J. Llwelyn), Free dinners for school children - - 191
Day scholars, attendance of at schools, favours the introduction of epidemic infection - - 34, 43
Day schools favourable to the incidence of epidemics - - 33
Deaf mutes, The physical, manual, and technical education of. (General Moberly) - - 237
Defective personal hygiene as it affects the teeth in infancy, childhood, and school life. (Geo. Cunningham) - - 71
Deformities which develop during growing life - - 107
Desguin (Victor), Assistance des Orphelins considérée au point de vue de leur Hygiène Physique et Morale - - - 175
Detection of chorea in school children - - - 23
Development of the reformatory and industrial school system in England. (Colonel Lenox Prendergast) - - - 146
Diggle (Joseph R.), Presidential address by - - - 7
Disinfecting apparatus necessary in school sanatorium - - 46
Dorsal curvature, description of - 107
Dot system of forming the characters in printing and writing for the blind - - - 23
Down (Dr. J. Langdon), remarks in discussion on the scientific observation and study of children in schools - - - - 1
Dwellings, large number of single-room, in Glasgow - - 13
——, legislative remedies for dealing with one-room - - 13

E.

Education Act of 1876, the Elementary, provisions of - 153
Education, danger of confounding with teaching - - - 8
—— of deaf mutes, The physical, manual, and technical. (General Moberly) - - - 237
—— of the Blind. (F. J. Campbell) - - - 224
——, physical, from the hygienic point of view - - - 116
——, Physical. (George White) - 110
——, the New, advantages of - 124
——, the object of physical - 116
——, The value of hygienic, to women. (A. T. Schofield) - 119
Elementary schools, physical exercises in - - - 114

Page

onditions favouring the
nent and spread of an,
s - - - 34
la - - - 44
empirical laws of
- - - 40
ools. (Dr. Shelly) - 30
ı ueber psychopatisch
rtige Kinder. (L.
l, J. L. A. Koch, E.
E. Hasse) - - 212
ormulärs, Entwurf eines,
suchung ueber psycho-
Minderwertigkeit der
- - - 217
(Dr.), remarks in dis-
n Kinder mit abnormer
ung - - - 221
ropologiques et anthro-
ıes dans la première
la Jeunesse, la Vie de
t l'Age adulte, nécessite
. de Tolosa-Latour) - 254
Swedish system of
- - - 113

F.

led, evils of neglecting
tion of the - - 205
importance of the care
nent of the - - 204
s. A.), remarks in dis-
ın some of the laws
fluence the growth of
- - - 109
F. Colcott), remarks in
ı on ringworm in ele-
schools - - - 29
rs for school children.
yn Davies) - - 191

G.

(Dr.), remarks in dis-
on the importance of
and treating defects of
l of hearing in school
- - - - - 262
r. Moritz), remarks in
ı on the scientific ob-
and study of children
- - - - 17
(Dr.), remarks in dis-
on some of the laws
luence the growth of
- - - 109

Page

Grimshaw (Dr. T. W.), remarks in discussion on L'enfant à Tendances Criminelles ou placé dans un Milieu criminel - - 175
Gutzmann (H.), Zur Hygiene der Sprache des Kindes - - 241
Gutzmann (Dr.), remarks in discussion on the importance of detecting and treating defects of vision and of hearing in school children - - - - 263
Guye (Prof.), remarks in discussion on Kinder mit abnormer Kopfbildung - - - 221

H.

Handwriting in relation to hygiene. (J. Jackson) - - - 47
——, origin and development of - 48
Hasse (Ernst), Strümpell (Ludwig), Koch (J. L. A.), Schmidt Emil). Antrag Erhebungen ueber psychopathisch minderwertige Kinder anzustellen - - - 212
Health Certificates, as a check on the introduction of infection into schools - - - - 42
——, Manual training in relation to. (Sir Philip Magnus) 123
Hearing, importance of detecting and treating defects of, in Board-school children. (Adolph Bronner) - - - 252
Hill (Dr. William), remarks in discussion on Kinder mit abnormer Kopfbildung - - 223
(Miss Davenport), remarks in discussion on L'enfant à Tendances Criminelles ou placé dans un Milieu Criminel - - 174
Holden (Dr.), remarks in discussion on Can hungry and half-clothed children be efficiently educated? 202
Hospital accommodation necessary for dealing with outbreaks of epidemic illness in large boarding schools - - - 45
Hull, the School Board for, Resolution submitted by - - 87
Hutton (Dr. H. R.), remarks in discussion on burial societies in relation to infant life insurance - 71
Hygiene, increasing education of the public in general - - 32

Page

Hygiene, Handwriting in relation to. (J. Jackson) - - - 47
—— value of the knowledge of personal and domestic, to mistresses, mothers, governesses, teachers, nurses, &c. - - 122
——, value of the knowledge of personal and domestic, to women 121
Hygiene der Sprache des Kindes. (H. Gutzmann) - - 241

I.

Idiots and Imbeciles, description of training given in institutions for 206
Imbecile children, care and treatment of - - - 206
Importance of detecting and treating defects of vision and of hearing in Board-school children. (Adolph Bronner) - - 252
Industrial schools, certified Day, established in 1876 - - 158
—— ——, contributions to voluntary (buildings) - - 152
—— —— Department of the London School Board, table showing cost of - - - 163
—— ——, tables showing children sent by the School Board for London to, during 1890, and since 1871 - - - 150
—— ——, table showing class of children sent to - - - 149
—— ——, table showing cost of - 160
—— —— under the management of the London School Board - 152
—— ——, voluntary, table showing the scale of payments made to the - - - - 151
—— —— system in England, Development of the reformatory and. (Colonel Lenox Prendergast) - 146
—— ——, the Brentwood - 152
Infant life insurance, Objectionable feature of some burial societies in their relation to. (Charles E. Paget) - - - 67
Infection, checks on the introduction of, into schools - - 42

J.

Jackson (J.), Handwriting in relation to hygiene - - - 47
Jacobi (Dr. A.), American child-labour laws - - - 57
Jacobi (Dr. A.), remarks in discussion on the scientific observation and study of children in schools - 17

K.

Kinder mit abnormer Kopfbildung. (Prof. E. Ritter von Hofmann) - 219
Knock knee, description of - 107
Koch (J. L. A.), Schmidt (Emil), Hasse (Ernst), Strümpell (Ludwig), Antrag Erhebungen ueber psychopathisch minderwertige Kinder auzustellen - - 212
Kotelmann (L.), Demonstrationen die Einführung der Steilschrift in die Schulen betreffend - 53
—— ——, resolution moved by - 294
—— ——, Ueber die Sehschaerfe der Schüler - - - 247
—— ——, remarks in discussion on some of the laws which influence the growth of the child - 109
Kuborn (Dr. Hyac.), Des Progrès de la Diffusion de l'Instruction publique en Belgique, au point de vue de la Criminalité et de l'Aliénation mentale - -
—— ——, L'Hygiène Scolaire en Belgique - - - 95

L.

Lane (W. Arbuthnot), Some of the laws which influence the growth of the child - - - 1
Lateral curvature, description of -
Laundry necessary in connexion with school sanatorium - -
L'Enfant à Tendances Criminelles ou placé dans un Milieu Criminel. (Théophile Roussel) - -
—— Pauvre. (Théophile Roussel)
L'Hygiène Scolaire en Belgique. (Dr. Hyac. Kuborn) - -

M.

Magnus (Sir Philip), Manual training in relation to health - 12
Maine, child-labour laws in - 6
Manual training, advantages of - 12
—— —— in relation to health. (Sir Philip Magnus) - - 12

Page

on (George), remarks in
sion on l'enfant à Ten-
Criminelles ou placé dans
lieu Criminel - - 174
d, child-labour laws in - 62
usetts, child-labour laws in 63
houses, separate, effect of,
aying the progress of an
nic in schools - 43
Professor James), remarks
e institution of the Caisse
le in Paris - - 202
chief epidemics of, in
s, occur at intervals of
two or three years - 41
demics, empirical laws of - 40
whooping cough, equality
en the number of school
en affected - - 32, 43
sentially the type of an
nic disease - - 39
minal returns for - - 44
Lord), remarks in discus-
on physical exercises in
ntary schools - - 118
—, remarks in discussion
n hungry and half-clothed
en be efficiently educated? 202
itions anthropométriques
1891) Tableau des maxi-
minimum, moyennes - 259-261
lly-feeble" child, care of
(G. E. Shuttleworth) - 208
—, measures adopted in
any for he care of the - 210
—, measures adopted in
ay for the care of the - 209
system of treating offen-
under 16 years of age - 146
l (William), Neglected chil-
in our towns and cities - 131
y (General), The physical,
al, and technical education
af mutes - - - 237
—, remarks in discussion
ne scientifi observation and
of children in schools - 17
(Malcolm), Ringworm in
entary schools - - 27
ty from preventible causes,
stics showing - - 120
le Dwellings Bill, objects of 136
s responsible for many epi-
cs before puberty - - 45
as a profession for the blind 229

N.

Page

Nécessité des Études anthropologiques et anthropométriques dans la première Enfance, la Jeunesse la Vie de l'Ecole et l'Age adulte. (M. de Tolosa-Latour) - - 254
Neglected children in our towns and cities. (William Mitchell) - 131
New Hampshire, child-labour laws in - - - - - - 61
New Jersey, child-labour laws in - 62
New York, child-labour aws in - 64
—— system of types for the blind compared with the Braille system - - - 235
Nigg (Marianne), Ueber die Nothwendigkeit der Reconvalescentenhäuser für Kinder - - 186

O.

Ohio, child-labour laws in - - 63
Over-pressure, resolutions respecting the question of mental - 95

P.

Paget (Charles E.), An objectionable feature of some burial societies in their relation to infant life insurance - - 67
Pankhurst (Dr.), remarks in discussion on free dinners for school children, and on Can hungry and half-clothed children be efficiently educated? - - - 201
Pennsylvania, child-labour laws in - 64
Physical education. (George White) - - - - 110
exercises in elementary schools Allan Broman) 114
indications of injurious schooling. (Dr. Octavius Sturges) - 20
Physical, manual, and technical education of deaf mutes. (General Moberly) - - - - 237
Prendergast (Colonel Lenox), The development of the reformatory and industrial school system in England - - - - 146
Presidential address. (Joseph R. Diggle) - - - 7
Progrès de la Diffusion de l'Instruction publique, en Belgique au point de vue de la Criminalité et de l'Aliénation mentale. (Dr. Ilyac. Kuborn) - - - 137

Q.

Page

Quebec, child-labour laws in - 61

R.

Reconvalescentenhäuser für Kinder, Ueber die Nothwendigkeit der. (Marianne Nigg) - - 186
Reformatory and industrial school ships, returns respecting, from 1886–1890 - - - 164–169
—— schools, table showing cost of 160
—— and industrial school system, Development of. (Lenox Prendergast) - - - - 146
Rhode Island, child-labour laws in- 62
Rhodes (Dr. Jno. Milson), remarks in discussion on the scientific observation and study of children in schools - - - 19
Richards (J. Peeke), remarks in discussion on the scientific observation and study of children in schools - - - 19
Rickets, observations on - - 106
Ringworm in elementary schools. (Malcolm Morris) - - 27
—— in elementary schools, systematic inspection for - - 28
Rötheln epidemics, before or after measles - - - 44
Roseola, epidemic - - 44
Roussel (Théophile), l'Enfant à Tendances Criminelles ou placé dans un Milieu Criminel - 170
—— ——, l'Enfant Pauvre - 196

S.

Sanitation and education, close connexion of, recognised in Glasgow - - 133
Schmidt (Emil), Hasse (Ernst), Strümpell (Ludwig), Koch (J.K.A.), Antrag Erhebungen ueber psychopathisch minderwertige Kinder anzustellen - 212
Schofield (A. T.), The value of hygienic education to women - 119
Schooling, Physical indications of injurious. (Octavius Sturges) - 20
Schools, Epidemics in. (Dr. Shelly) - - - 30
——, importance of subdivision into two distinct establishments, in large - - - 43

Page

Scientific observation and study of children in schools, and the classes into which they may be grouped. (Dr. Francis Warner) 10
Schschaerfe der Schüler, ueber die. (L. Kotelmann) - - 247
Servants, separate accommodation necessary for, in large boarding schools - - - 46
"Shaftesbury" training ship - 152
Shelly (Dr. C. E.), Epidemics in schools - - - 30
Shuttleworth (G. E.), The care of the "mentally feeble" child (as distinguished from the "imbecile" - - - 208
—— ——, remarks in discussion on the scientific observation and study of children in schools and the classes into which they may be grouped - - - 15
Skeleton, variations in the forms of the bones of the human - 104
Smith (Noble), remarks in discussion on the scientific observation and study of children in schools - - - 19
—— ——, remarks in discussion on handwriting in relation to hygiene - - - 57
—— ——, remarks in discussion on physical exercises in elementary schools - - - 118
Some of the laws which influence the growth of the child. (W. Arbuthnot Lane) - - 103
Spencer (Herbert), quoted on the importance of the science of hygiene to human health and happiness - - - 119
Sprache des Kindes, zur hygiene der. (H. Gutzman) - - 241
State interference in the upbringing of children, necessity for - 9
Statistics showing proportion between crime and population in Belgium - - - 138, 139
Steilschrift, die Einführung der, in die Schulen betreffend. (L. Kotelmann) - - - 53
Strümpell (Ludwig), Koch (J. L. A.), Schmidt (Emil), Hasse (Ernst), Antrag Erhebungen ueber psychopathisch minderwertige Kinder anzustellen - 212

Page

Sturges (Octavius), Physical indications of injurious schooling - 20
Suicides in Belgium, increase in number of - - - 145
Swedish system of exercises - 113

T.

Table giving general analysis of cases in the scientific observation and study of children in schools 12
Table showing conditions presented by school children with low nutrition - - - 14
Teaching, danger of confounding education with - - 8
Teeth in infancy, childhood, and school life, Defective personal hygiene as it affects the. (Geo. Cunningham) - - - 71
Tolosa-Latour (M. de), Nécessite des Études anthropologiques et anthropométriques dans la première Enfance, la Jeunesse, la Vie de l'Ecole et l'Age adulte - 254
Tooth-brushes, varieties of - 77
Tooth-powder, action of - - 79
Towns and cities, Neglected children in our. (William Mitchell) 131
Truant-schools in London - 153
—— ——, two distinct systems of management in - - 156
Truant school, the Upton House - 154
Turner (Sydney), the originator of the reformatory school system 146
Typhoid fever, protective influence of vaccination destroyed by - 45

U.

Upton House truant school - 154

V.

Vaccination, protective influence of, destroyed by typhoid fever - 45
Value of hygienic education to women. (Dr. A. T. Schofield) - 119
van Praagh (William), remarks in discussion on the importance of detecting and treating defects of vision and of hearing in school children - - - 264
Variola, decrease of, during recent years - - - - 32, 45
Vermont, child-labour laws in - 62
Vision, Importance of detecting and treating defects of, in Board School children. (Adolph Bronner) - - - 252
von Hofmann (Prof. E. Ritter), Kinder mit abnormer Kopfbildung - - - 219

W.

Warner (Dr.), amendment moved by - - - 224
—— ——, The scientific observation and study of children in schools, and the classes into which they may be grouped - 10
White (George), Physical education - - - 110
Whooping cough and measles, equality between the number of children affected by - - 32, 43
—— ——, terminal returns for - 44
Woodward (Dr.), the developer of manual training in American schools - - - 128
Working curve of an hour: an experiment concerning over-pressure of brain. (Dr. Leo Burgerstein) - - - 87
Workshop instruction, requisite conditions for - - - 128
Writing, evils of sloping - - 49
——, posture commonly prescribed for sloping - - - 51
——, vertical, advantages of - 50

LONDON: Printed by EYRE and SPOTTISWOODE,
Printers to the Queen's most Excellent Majesty

TRANSACTIONS

OF THE

Seventh International Congress of Hygiene and Demography.

LONDON, AUGUST 10TH–17TH, 1891.

Patron:—HER MAJESTY THE QUEEN.

President:—H.R.H. THE PRINCE OF WALES, K.G.

VOLUME V.

SECTION V.

CHEMISTRY AND PHYSICS IN RELATION TO HYGIENE.

EDITED BY C. E. SHELLY, M.A., M.D.

Assisted by the HONORARY SECRETARIES of the SECTION.

LONDON:
PRINTED BY EYRE AND SPOTTISWOODE,
PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY.

1892.

- 16861 -

ASTOR LIBRARY
JUN
6
1893
NEW YORK

OFFICERS OF THE SECTION.

PRESIDENT.

Sir H. E. Roscoe, LL.D., F.R.S., M.P.

HONORARY PRESIDENTS.

Professor Dr. Victor Meyer, Heidelberg.
Professor Dr. Max von Pettenkofer, Munich.
Professor Dr. Pouchet, Paris.

VICE PRESIDENTS.

Sir Chas. Cameron, F.R.C.S., D.P.H.
Professor W. Odling, M.B., F.R.S.
Professor W. J. Russell, Ph.D., F.R.S.
Lieutenant-General R. Strachey, R.E. C.S.I., F.R.S.

HONORARY VICE-PRESIDENTS.

Professor C. F. Chandler, New York.
Professor F. H. Foret, Morget, Lausanne.
Professor Fresenius, Wiesbaden.
Professor Dr. A. Gautier, Paris.
M. Ch. Girard, Paris.
Professor J. H. van't Hoff, Amsterdam.
M. Albert Lévy, Montsouris Observatory, Paris.
Professor K. B. Lehmann, Würzburg.
Professor Oscar Liebreich, Berlin.
Herr Stadtrath Marggraff, Berlin.

COUNCIL.

Jas. Bell, C.B., Ph.D., D.Sc., F.R.S.
A. Buchan, M.A., LL.D., F.R.S.E.
A. Dupré, Ph.D., F.R.S., F.I.C.
Alfred E. Fletcher, F.C.S., F.I.C.
O. Hehner, F.C.S., F.I.C.
Baldwin Latham, M. Inst. C.E., M. Inst. M.E., P.R. Met. Soc.
W. Marcet, M.D., F.R.S.
W. C. Roberts-Austen, C.B., F.R.S.
R. H. Scott, M.A., F.R.S.
T. Stevenson, M.D., F.I.C.
J. C. Thresh, D.Sc., M.B.
C. M. Tidy, M.B., F.C.S.
C. Theodore Williams., M.A., M.D.

HONORARY SECRETARIES.

Charles E. Cassal, F.C.S., F.I.C.
Harold G. Colman, Ph.D., M.Sc.
Edward Mawley, F.R.Met.Soc.

TABLE OF CONTENTS.

	Page
Presidential Address	7
On Town Fogs and their Effects	11
The Air of Large Towns: Methods of Analysis	22
Discussion	26
The Means at our Disposal for Preventing the Emission of Smoke from Factories and from Dwelling Houses	28
Discussion	37
Demonstration of the Possibility of Removing the Smoke of Fires from the Air of Towns and of Using it for Disinfecting Sewers	37
The Chemical Treatment of Sewage with special reference to the Treatment of London Sewage	39
Chemical and Physical Processes employed in the Treatment of Sewage	40
The Duty of a Locality to Utilise the Nitrogenous Matter in its Sewage for the Benefit of the Nation	48
The Power of the Soil and Vegetation combined to Destroy Disease Germs, and so to Prevent the Possibility of the Spread of Enthetic Disease in consequence of Sewage Farming	54
Discussion	59
Kritische und experimentelle studien über die hygienische Bedeutung des Kupfers	63
Discussion	74
The Action of Water on Lead	75
Discussion	82
What is the Importance of Magnesia in Drinking Water?	82
Discussion	88
The Importance of Periodical Analysis of the Air Breathed in Towns and Cities	88
Discussion	92
On the Effects of the Respiration of Carbonic Acid on Man	93
Discussion	98
Meteorology in Relation to Hygiene	98
Discussion	104
Influenza and the Weather of London	106
Discussion	110
Recent Hygienic Improvements in the Manufacture of Bread	111
Discussion	116
Bromine and Iodine as Aërial Disinfectants: and on a New Method of Applying them	117
Discussion	119
INDEX.	

SECTION V.

CHEMISTRY AND PHYSICS IN RELATION TO HYGIENE.

Tuesday, 11th August, 1891.

The President, Sir Henry Roscoe, M.P., LL.D., F.R.S., in the Chair.

Presidential Address

BY

Sir Henry Roscoe, M.P., F.R.S., LL.D., D.C.L.

The branch of the great subject of Hygiene with which we in this section have to deal, viz., that of the relation in which it stands to the sciences of chemistry and physics, is one of primary importance and interest. Indeed, taken in its most general sense, the relation of the science of health to chemistry and physics will be found to include almost all the varied subjects which come under the cognisance of this Congress, for all vital processes are regulated by chemical and physical laws, and physiology may be defined as the chemistry and physics of the animal body. Hence the preservation of a normal condition, or of health, being dependant upon these laws, it is clear that our Section is the most important of all, for it is by obeying chemical and physical laws that health is maintained, whilst by neglecting to follow them we court disease and death.

But whilst as chemists and physicists we may claim credit for laying the foundations of the edifice of Hygienic Science, we gladly admit that portions of the building have been raised by other hands, and heartily do we welcome the successful efforts which the biologist, the physician, the engineer, and the statesman have made to help us to complete the building up of a condition of things by which the amount of preventible disease is reduced to its possible minimum, and that of health and well-being increased to the maximum possible under the necessary circumstances of our lives.

As to the progress which during the last half century has been made towards the attainment of this end—he who runs may read. Those who can carry their minds back 50 years will be free to confess that at that time, whether in England or abroad, the principles of Sanitary Science were recognised only by a very few men of light and leading, and that any attempt to carry out these principles were, indeed, few and

far between. Fifty years ago our notions of the nature of contagion, of the causes which lead to the spread of epidemic diseases were of the crudest and vaguest description. We then had no idea of the fact now not only proved beyond doubt, but strongly impressed on the public mind, that both water and milk are fertile carriers of disease if contaminated even ever so slightly with infectious material.

In those days "pump" water was believed to be wholesome if only it was cool and sparkling, and water from a source now recognised as dangerously impure was preferred to the pure article which came from a distance in the city mains. Now the sanitary authority closes all doubtful wells, and municipalities incur vast expense in bringing home to every one a pure supply of this necessity of life. Still much remains yet to be done for an adequate supply—especially in rural districts where the village pump is too often the sole means of existence, and where that pump is not infrequently in close proximity to sources of dangerous impurity. Moreover, even where the supply is of good quality, its quantity often fails in dry seasons from lack of any impounding system of the flood waters. That 50 years since our knowledge of these matters was limited is due to the fact that in those days chemists were unable to decide whether a water was harmless or dangerous. The methods of analysis were then crude and insufficient; and even now, when these methods have been greatly improved, the most expert analysts may find themselves in disagreement, on a mere chemical examination, as to whether a given water is fit to drink or not. The discussion of these methods of examination on Thursday next may, I should hope, contribute to the elucidation of these doubtful points.

Fifty years since no one realised that the existence of cesspools under their houses, of which there were then thousands in London, was a source of danger to the inhabitants. The idea of getting rid of and of utilising fœcal matter was laid hold of ages ago by nations, such as the Chinese, whom we in our wisdom term barbarians, whilst the civilised European waited till the middle of the nineteenth century before he discovered that if he would preserve his life he must remove from his neighbourhood the refuse which accompanies that life, and even now, at the end of the century, he is far from having solved the question of the best way of its removal, much less that of its utilization. On Wednesday next we shall have an opportunity of learning the opinion of those competent to give it on the much vexed questions of the chemical and physical principles involved in the treatment of sewage; and if we can lay down, even in outline, what these principles are, our section will not have met in vain.

The question of air pollution, which will come on for discussion during our sittings, is a much more difficult though an equally important one. We can bring pure water into our houses by pipes, we can also take away the polluted water by sewers, we can see the fresh water running in, and we know, if our drains are in order—an assumption it is true, and perhaps a bold one—that our dirty water at least goes away from us. In the case of the air, we cannot regulate the fresh supply so easily; nature, it is true, does much for us, indeed if she did not, we should be badly off. We cannot see the air, whether pure or otherwise;

our sense of smell, may, if it be sensitive—which is again an assumption often incorrect—possibly tell us that something is wrong, though it by no means follows that an odourless air is pure and healthy; but to ascertain how far the air is impure, and to express it in figures was, so far as concerns many of the most important of these impurities, impossible 50 years ago, and is only now beginning to be understood. But even were we able to detect the presence in the air of the spores of the as yet undetected influenza microbe we should be far from having a means of freeing the air from it. By filtration through cotton wool, air can be obtained practically free from microbic life as well as from dust particles and fog, but such air filtration can only be adopted in a very limited number of cases, and is altogether useless for general purposes. One of these few instances is that of the House of Commons, where a system of air filtration has been successfully adopted, by which the air of the debating chamber has been preserved perfectly free from fog as well as from microbic life if the doors are kept closed.

The discussion on town fogs and their prevention, which is to be introduced by Dr. Russell, will enable us at any rate to form an idea of the causes and possible mode of preventing these serious drawbacks to a city life. A scientific inquiry, if it does not at once succeed in finding a cure for the evil may, at least, point the way to prevention, and I shall be surprised if we do not find that the ultimate panacea will consist in using gaseous fuel and the electric light.

Another source of air pollution, more easy to grapple with, lies in the escape of deleterious gases from chemical works and other manufactories. The removal of many causes of such pollution has been satisfactorily accomplished in this country under what are known as the Alkali Acts, or more properly the Noxious Vapours Acts. Thanks to the care with which these Acts have been worked both by the Government inspectors and the manufacturers themselves, the serious complaints which arose of nuisance due to the escape of acid and other noxious vapours are now no longer heard; and not only has the public been the gainer by the stoppage of the escapes which formerly occurred, but the manufacturers themselves have also benefited, inasmuch as they have had their attention directed to improvements in their processes which have proved remunerative.

The great smoke question is one upon which I hope some light will be thrown by the discussion which will take place during our meeting. Much, doubtless, can be done in preventing the output of smoke from factories and other places in which large quantities of coal are burnt, but, after all, the smoky atmosphere of our towns is caused chiefly by the thousands of domestic fires, and at once to alter these so as to prevent smoke, or to insist upon gaseous fuel being generally used instead of coal, is to expect the impossible.

I have said that the foundation of hygienic progress is to be sought in the application of chemical and physical principles. This is true not only of the matters of every day experience to which I have already referred, but also of the most recent and astounding discoveries, showing the dependence of the health of the community on the actions of microbic life. Thus Pasteur and his pupils have proved that these actions on the

host or body receiving the microbes as guests, are to be attributed rather to definite chemical products formed by the living micro-organisms than to the organisms themselves. For just as in the well-known instance of the vinous fermentation, the products of the action of the yeast plant on sugar are alcohol, carbonic acid, and subsidiary compounds, so each definite micro-organism—such, for example, as that peculiar to diphtheritis—engenders certain active chemical principles which are capable of effecting serious or fatal changes, characteristic of this disease, within the animal body. Hence the ultimate causes of epidemic disease rest upon a chemical basis, and as we find in a simple chemical an antidote for poisoning by any of the commoner chemical poisons, so it would appear that an antidote for hydrophobia, for example, is to be found in the complicated chemical products of the life of the micro-coccus characteristic of this disease. How these antidotes—except in the most simple cases, such as acid and alkali and the like—act is as yet unknown. We do, however, know that the growth and life functions of this yeast plant are stopped in presence of an excess of the poison, alcohol, which it secretes, and this fact may help us to explain, to some extent, the protective action exerted by the chemical poison developed by many pathogenic micro-organisms. The elucidation of this subject, all-important for the health of the community as well as of the individual, is one of the most pressing scientific needs of the day. To isolate the various chemical products, to study their actions, both chemically and pathologically, is a necessary step towards the attainment of the end which we all have in view, viz., the prevention and cure of disease. Hence, it will be admitted by all, that whilst the determination of the morphological characters of micro-organic life is an essential preliminary, it is to the examination of the life-functions of the organism, and especially to those connected with the production of its peculiar chemical poison, that we must look for the complete solution of the problem; and therefore it is in the laboratory of the chemist, and by the application of chemical and physical methods of research that progress in these matters will, in the coming time, be made. So again, I say that the foundations of hygienic progress are to be sought in the application of the principles of chemistry and physics.

And now, gentlemen, I know that all well-wishers to this progress, whether English members or the foreign guests who have honoured the Congress by their presence, will rejoice to learn that we in England, determined no longer to lag behind our continental friends, are about to establish a National Institute of Preventive Medicine, in which not only researches of the kind I have alluded to can be satisfactorily carried out, but where instruction in the numerous special branches of science, upon which the health of the nation depends, can be given. Those who have interested themselves in this movement feel that it is no less than a national disgrace, that whilst almost every other civilised nation has established an institute of the kind in its midst, we in England should stand alone inactive and supine. We believe that the necessity for such a national institute only requires to be made generally known to be universally acknowledged, and we feel confident that now having

obtained the first step towards the attainment of our object, viz., recognition under license of the Board of Trade, the Council of the Institute will only have to ask in order to obtain the considerable amount of pecuniary support necessary for carrying on the work of the institute on a scale worthy of the country. This support must come wholly from private sources; for our Government, unlike that of many countries, as yet holds aloof from supporting institutes of this kind however necessary they may be to the general well-being of the country. The time may not be far distant when different views will prevail, and when Parliament will consider it one of its first and most binding duties to support by Imperial grant an institution whose sole aim is that of increasing our knowledge of the conditions upon which the health of the nation ultimately depends, and of diffusing that knowledge widely throughout the land.

A vote of thanks was accorded to Sir Henry Roscoe on the motion of Dr. Russell, seconded by Professor Odling.

On Town Fogs and their Effects.

BY

Dr. W. J. Russell, F.R.S.

Until 1880 the formation of fog was looked upon as arising simply from the separation of liquid water, probably in the form of hollow vesicles, from an atmosphere saturated with aqueous vapour; but in that year Aitken showed that the determining cause of the separating out of liquid water, and consequent formation of fog, was dust present in the air. He pointed out that a change of state, a gas passing to a liquid or a liquid to a solid, always occurred at what he terms a "free surface"; that as long as a molecule of liquid water is surrounded by like molecules (and the same with gaseous water) we do not know at what temperature, or whether at any temperature, they would change their state; but if in contact with a solid, then—at the surface where they meet—the change will occur. If the solid be ice it may become liquid; or the liquid may become solid; and the same kind of action occurs when the liquid is in contact with its own vapour. In fact, what we call the freezing and boiling points of a body are the temperatures at which these changes take place at such free surfaces. The dust always present in the atmosphere offers this free surface to the gaseous water, and thus induces its condensation. This specific action of dust varies very considerably,—first with regard to its composition, and second with regard to the size and abundance of the particles present. Sulphur burnt in the air is a most active fog producer; so is salt. Many hygroscopic bodies form nuclei having so great an affinity for water that they can cause its condensation from an unsaturated atmosphere. At the same time non-hygroscopic bodies,

such as magnesia and many others, are powerful fog-producers; no doubt their activity may in part be attributed to their being good radiators of heat, and thus by becoming cooled, inducing condensation. Mr. Aitken also showed that the products of combustion, even when the combustion is perfect, are powerful fog producers,—a fact which has an important bearing on the production of town fogs. One other point in these experiments I cannot omit mentioning; it is the exceedingly minute amount of matter capable of inducing fog. In his first series of experiments, Mr. Aitken showed that $\frac{1}{100}$ of a grain of iron wire, however often it was heated, evolved on each heating sufficient dust to cause a visible fog; and afterwards, with still more delicate apparatus, that $\frac{1}{2000}$ of a grain of either iron or copper when treated in the same way gave a similar result; and from these last experiments he infers that even $\frac{1}{100000}$ grain of either wire, if only slightly heated, would yield sufficient nuclei to cause a visible amount of fog. It is of much importance and interest, seeing how small a quantity of dust is required for the production of fog, to know that even this small amount may be filtered out of the air by passing it through cotton wool, and that an air may thus be obtained in which a fog cannot be produced. Mr. Aitken's description of such an atmosphere is at first most alluring; for he says that if there was no dust in the air there would be no fogs, no mists, and probably no rain; but he goes on to state that when the atmosphere became burdened with supersaturated vapour, it would convert everything on the surface of the earth into a condenser, every blade of grass and every branch of a tree would drip with moisture deposited by the passing air, our dresses would become wet and dripping, and umbrellas useless; but our miseries would not end here, for the inside of our houses would become wet, the walls and every object in the room would run down with moisture. I think if we picture to ourselves this state of things we may be thankful that there is dust—and fog. Dust in its finer forms is invisible to us, but as its delicate particles become loaded with moisture, it becomes a fine mist, which is dense if the number of particles are many. But if the dust particles are fewer, the amount of aqueous vapour remaining the same, each particle will have a larger amount of condensed moisture to carry, and will give rise to a more coarse-grained fog; the moisture, or some of it, will be more feebly attached to its nuclei, producing then what is known as a wet fog; whereas at least one most important fact in the production of a dry fog is the strong affinity between the nuclei and the condensed vapour. As most of you are no doubt aware, Mr. Aitken has invented a most ingenious method for counting the number of dust particles in air, and has obtained most interesting and valuable results. I can only mention here that some of these results deal with the clearness of air in relation to the number of dust particles present; and other results show how little effect rain has in diminishing the amount of the finer dust in air. Towns obviously supply dust of all kinds, and therefore offer every inducement for fogs to form, and some at least of these dust particles will be capable of causing the condensation of moisture even from an atmosphere which is not saturated with aqueous vapour. This condensation of moisture is a very complete process for removing all kinds of impurities from the air. Floating

particles are free surfaces, and, becoming weighted by the moisture they condense, tend to sink; even the gaseous impurities in the air will be dissolved and carried down by the moisture present. Experiment confirms this, for it has been proved how correctly the impurities of an air can be ascertained by determining the composition of dew, even if this be artificially and locally formed. It is of importance to note that even the purely gaseous emanations from our towns cannot pass away when a fog exists, as is shown by the accumulation of carbonic acid which takes place during a fog. Taking four volumes in 10,000 volumes as the normal amount of carbonic acid in London air, some years ago I found that it increased in the case of a dense fog to as much as 14·1 volumes, and often to double the normal amount, which must represent a very serious accumulation of the general impurities in the air.

A fog in this way becomes a useful indicator of the relative purity of the atmosphere in which it forms. If pure aqueous vapour be condensed it gives a white mist—a country fog, a sea fog—and a white light seen through it is not converted into a red light; but in town fogs the whiteness of pure mist disappears and becomes dark, in some cases almost black, in colour, the change being produced by the foreign matters floating in the air. By far the most abundant colouring matters of our town fogs are the products generated by the imperfect combustion of coal, but in addition to these bodies, many others must obviously find their way into the air over a town; especially will there be dust from the universal grinding and pounding going on in street-traffic and many mechanical operations, from the general disintegration of substances and the decomposition of perishable materials, all of which will add something to the air, and will become an integral part of the fog. However, although it is often said that a town fog is so dense that it may be cut with a knife, still it is difficult to condense so much of it that it can be subjected to a searching chemical analysis. In 1885 by washing foggy air I was able to determine the amount of sulphates and chlorides present, and—as indicators of organic matter—the quantity of carbon and nitrogen in the fog. The results showed strikingly how largely the amounts of organic matter and of ammonia salts in the air varied with the weather. No case of dense fog occurred when the experiments were being made, but the mean of several experiments clearly showed that in foggy weather the amount of organic matter was double as much as existed in the air in merely dull weather, and that the amount of sulphates and chlorides increased under like conditions, but not to the same extent. Fog may, however, be made to give its own account of its constituents; for we have only to collect and analyse the deposit which it leaves to learn what its more stable constituents are. We have to thank the air analysis committee of the Manchester Field Naturalists' Society for the most complete analysis of such a deposit which has yet been made. The deposit analysed occurred during the last fortnight in February of this year, 1891, and was obtained from the previously washed glass roof of the plant houses at Kew, and from Messrs. Veitch's orchid houses at Chelsea. At Kew 20 square yards of roof yielded 30 grammes of deposit. At Chelsea the same area gave 40 grammes,

which represents 22 lbs. to the acre or six tons to the square mile, and the composition of these deposits is as follows :—

	Chelsea.	Kew.
Carbon	39·0	42·5
Hydro-carbons	12·3	4·8
Organic bases (pyridines, &c.)	2·0	
Sulphuric acid (SO_3)	4·3	4·0
Hydrochloric acid (HCl)	1·4	0·8
Ammonia	1·4	1·1
Metallic iron and magnetic oxide of iron	2·6	41·5
Mineral matter (chiefly silica and ferric oxide)	31·2	
Water, not determined (say difference)	5·8	5·3
	100·0	100·0

These analyses give, I believe for the first time, a definite account of the composition of fog deposits. Soot and dust rendered sticky and coherent by hydrocarbons are by far the principal constituents, but I should like to give you the striking description which Professor Thiselton Dyer has sent me of the deposit collected at Kew. He says "it was like a brown paint, it would not wash off with water and "could only be scraped off with a knife. It thickly coated all the "leaves of the evergreens, and upon what have not yet been shed it "still remains." In the above analysis it is curious to note the large amount of metallic iron and magnetic oxide of iron. The details with regard to these very interesting analyses we shall hear from a member of the Manchester Committee, and I will only ask you to note how large a proportion of these deposits arises from the imperfect combustion of coal. We also learn from the Manchester Committee some interesting facts with regard to fog deposits which occurred last winter in the city. The deposit which was collected from aucuba leaves contained as much as 6 to 9 per cent. of sulphuric acid, and 5 to 7 per cent. of hydrochloric acid, mostly of course in a state of combination, but the deposit was, they say, "actually acid to the taste." Moreover, three days' fog deposited per square mile of surface, in by no means the worst part of Manchester, 1½ cwts. of sulphuric acid, and even as far out of the city as Owens College, on the same area, over 1 cwt. of acid and 13 cwts. of blacks.

There is still one other point characteristic of town fogs to be noted; it is their persistency in an atmosphere considerably above the dew point. A country fog under such circumstances at once passes away; a town fog apparently does not do so. There seem to me to be two reasons for this; one is that the moisture is protected, and its evaporation to a large extent hindered, by the presence of oily matter; and secondly, that when the moisture has really gone, the soot and dust remain to produce a haze. The great distances to which fogs will travel is also remarkable, for they have on many occasions been traced to a distance of at least 25 to 35 miles from London, and I believe I might say to 50 miles.

I have so far discussed the production and composition of town fogs; and before considering their effects, would say a word

on the question of whether in London they are increasing in frequence and density. A complete and accurate record of fogs in London is not kept; several stations are required, and a correct method of registering the density and of distinguishing the difference between haze and fog is necessary, but fortunately there is a fair approximation to this complete registration of London fogs published by the Meteorological Office in their daily reports. The observations are made every morning at Brixton and every afternoon at Victoria Street; and, from a paper by Mr. Brodie on "Some remarkable features in the winter of 1890–91" published in the journal of the Royal Meteorological Society, I learn that the number of fogs thus registered as having occurred each winter since 1870 is as follows:—Winter being represented by the months, December, January, and February. I have divided these 20 years into four groups or five years each—

Between	1870–1875	93	fogs occurred.
„	1875–1880	119	„
„	1880–1885	131	„
„	1885–1890	156	„

It appears, then, that during the last 20 years there has been a steady increase in the number of winter fogs. I am not aware of any data to prove whether the density of these fogs has increased, but it is probable that the increase in number of fogs largely depends upon an increase of atmospheric impurity, and on the conversion of haze and mist into obvious fog; and as the great colouring matter of fog arises from the combustion of coal, I have drawn up the following table from information which has been kindly furnished to me by Mr. G. Livesey and Mr. T. B. Scott, of the Coal Exchange. It gives the amount of coal really consumed annually in London, but does not include the coal used by the different gas companies.

COAL CONSUMED IN LONDON.

(That used by Gas Companies deducted).

Year.	Tons.
1875	4,882,233
1876	4,988,280
1877	4,143,909
1878	4,973,147
1879	5,833,891
1880	5,334,823
1881	5,598,281
1882	5,343,974
1883	5,872,310
1884	5,669,281
1885	6,026,063
1886	6,096,732
1887	6,231,956
1888	6,463,498
1889	6,390,850

For the first five years the amount given in the table is rather too high, as the quantity used by the surburban gas companies could not be ascertained and deducted. The quantities apply to what is known as

the London district, an area with an average radius of 15 miles round London. The table shows an absolute increase during the last 15 years of two million tons of coal, that is, half as much again is now burnt as was burnt in 1875.

Supposing only 1 per cent. of sulphur in this last yearly amount is converted into sulphuric acid ($H_2 SO_4$) and passed into the air, it would give 195,720 tons of this acid. The five years' averages of winter fogs give a steady increase, but obviously the number in each winter will vary much with the atmospheric conditions; for instance, last winter was remarkably favourable for the development of fog; for again taking the figures of the last 20 years, the average number of days of fog during the winter is 25, but last winter the actual number was 50. A form of fog well termed "high fog" now frequently occurs in London. The lights in a street during this form of fog are often as visible as on a clear night, but above hangs a fog so dense that the darkness of night prevails during the day. This particular form of fog appears to have become much more frequent of late years; in fact it is doubtful whether in former times it ever occurred. The immediate cause of this new form of fog is difficult to explain.

The general atmospheric conditions which induce fog are a still and moist air and a high barometer—a state of the air most usual under anticyclonic conditions. The immediate determining cause, however, of a fog is usually a sudden and considerable fall of temperature. Mr. Brodie also points out that last winter was a time of calms; the percentage of such days on the average for the last 20 years is 9·7, but last winter the number was 22; emphatically, he says, it was an anticyclonic winter.

London has always been the head-quarters of town fogs, but now all the large towns appear to be imitating it in this respect. This is what we must expect, for an increase of population means an increase of combustion of coal, and that means a pouring into the atmosphere of more and more carbon, hydrocarbons and sulphuric acid; in dry and windy weather all these bodies may be scattered so as not to produce appreciable effects, but let the air be still, or even approach a state of aqueous saturation and then, as we have seen, every particle of dust and dirt becomes a centre for moisture to deposit on, and we shall have a fog imprisoning all impurities and offering them to us for inhalation. To burn coal so that only products of complete combustion may escape is a problem of much difficulty and is comparatively rarely done. Certainly the domestic fireplace does not do it, but, on the contrary, is the principal cause of the dark colour of our fogs. Many manufacturers, however, liberally contribute to produce the same effect.

I turn now from the constitution and production of fog, to note some of the effects it produces. First, with regard to health; details on this point I leave to those who are more able to describe them than I, but I have a few words to say with regard to the effect of London fogs on the death-rate in general. There are many people who feel so strongly the unpleasantness of fog that it induces them to magnify its results and make extraordinary statements with regard to the mortality it produces. It has even by some been likened in deadliness to the Great Plague of London and to other great epidemics. To ascertain how far such views

were correct I studied the Registrar-General's reports for the times of fogs, and expressed his results by the curves drawn on a series of diagrams.* I selected times of fog, viz., the winters of 1879–80, 1889–90, and 1890–91, and represented graphically the temperature, the amount of fog, and the death-rate for each day. The results are, I think, worthy of careful study. The first thing learned from these diagrams is that by far the greater number of fogs occur when there is a great fall of temperature; this is closely followed after a few days by a great increase in the death-rate; how much of this increase is to be attributed to the fog and how much to the fall in temperature may be difficult to determine. We have evidence that when fogs occur without fall of temperature, they do not appear to be followed by any remarkable increase of death-rate, for on December 15th 1889 there was a dense fog and the temperature was even above the average, and under these conditions the death-rate remained far below the average; on December 13th and 14th in the same year again there is a dense fog, and average temperature, and only an average death-rate, and the same thing happened on February 4th in 1890, when, notwithstanding a dense fog, the death-rate remained remarkably low; and last winter on November 13th and 14th there was again a dense fog, a high temperature, and an average death-rate. With these four exceptions, depression of temperature goes with fog. There is no case of depression of temperature not followed by increase of death-rate.

That many people suffer much, both physically and mentally from the effects of fog there can be no doubt; but as far as I can interpret these returns of the Registrar-General, they do not confirm the popular impression that fog is a deadly scourge; at the same time it is beyond doubt that an atmosphere charged with soot, dust, and empyreumatic products is an unwholesome atmosphere to breathe; though I think that the principal cause of the great increase of mortality when fogs occur is attributable rather to the sudden fall of temperature which usually accompanies fog than to the fog itself.

So many toxic effects are now traced to the action direct or indirect of bacteria, that it is satisfactory to learn from the experiments of Dr. Percy Frankland that fogs do not tend to concentrate and nurture them; for he found there were remarkably few bacteria in London air during a time of fog.

The deleterious action of town fogs on plants is more marked and more easy to investigate than its effects on animals. Nurserymen have long known from experience that a town fog will penetrate even their heated greenhouses, and will with certainty kill many of their plants, especially their orchids, tomatos, and in fact most tender and soft-wooded plants. But on this point I cannot do better than quote what the Director of Kew Gardens, Professor Thiselton Dyer, says in a letter to me:—"With regard to plants under glass the "effect of fog is of two kinds. i. By diminishing light. This checks

* The diagrams here referred to were exhibited at the Congress.

" transpiration. The plants are therefore in the condition of being " overwatered, and a well-known consequence of this is to make them " shed their leaves wholesale. Many valuable plants which ought to be " well furnished with foliage become perfectly bare and it is impossible " ever again to recover them into sightly specimens. ii. The toxic " influence of the fog. This is most striking. It is illustrated in the " most forcible way by the enclosed memorandum.* I attribute it in the " main to sulphurous acid though I cannot help suspecting that some " hydro-carbon may also have something to do with it. The toxic " effect varies from one plant to another, some are scarcely injured " others are practically killed." He adds, " I hope you will be able to " arouse some interest in this horrible plague. If the visitation of last " year is annually repeated it must in time make all refined horticulture " impossible in the vicinity of London." I append to this paper the very interesting and important report from Mr. W. Watson to which Professor Dyer refers. This fog action on plants is so clearly marked and so deadly that it has, I am happy to say, led the Horticultural Society, aided by a grant from the Royal Society, to undertake a scientific investigation of the matter. Plants are so much more easily dealt with than people—all the circumstances of their attack by the fog and its immediate results are so much more easily noted and traced—that the investigation has already yielded important results, and we shall, I hope, hear from Professor Oliver, who is devoting himself specially to the investigation, some account of his latest results. A marked and admitted difference between town and country fogs is, that while a country fog is harmless in a greenhouse, a town fog will produce most destructive results.

There is still another action of town fogs and one which I believe is of the greatest importance. I mean its power of absorbing light. This power of abstracting light depends principally on the amount of coal products which the fog contains. The slower vibrating red rays can struggle through a fog which is absolutely impervious to the more refrangible ones. Even a mist but slightly tinged with smoke is opaque to the blue rays and this screens us from their action; but, as Aitken has lately shown, the heat rays can pass through readily. This opacity of town fog to light is, I believe, one of its most serious and detrimental characters; animals can no more thrive in semi-darkness than can plants, and important as the red rays may be, still it is undoubtedly the blue rays which are most active in producing the principal chemical changes going on around us. Experiments lately made have strongly impressed me with the wonderful activity which light confers on a mixture of air and moisture. Oxidations which in dulness and darkness are impossible, are easily and rapidly effected by aid of a gleam of sunshine, or even by a bright diffused light. It is not possible, I believe, for people to remain healthy where this source of chemical activity is cut off or even seriously diminished. In addition to the loss of physical energy, mental depression is induced by the absence of light; the whole tone of the system becomes

---

* *Vide* Appendix to this paper.

ered and may fall a prey to actions which under brighter conditions ould have been able to resist.

There is another action of light which is potent for good. I mean lestructive action on many forms of bacteria. Professor Koch at the meeting of this Congress pointed out how his tubercle bacilli are d by even a short exposure to sunlight, and it is now well established inimical light is to the growth and development of most kinds of eria. I wish I could show you in some perspicuous way the mous power which town fog has of absorbing light, and bring ibly before you the great difference which exists between the amount ght which reaches the inhabitants and buildings of a town as com- d with the amount on an equal area free from smoke. A simple nometer is much required, and I hope the want will soon be supplied; at present the only records bearing on this point are the observations irect sunshine made at various stations by the Meteorological Society the Meteorological Office with the Campbell-Stokes instrument, and e interesting observations by Mr. H. Raffles on the distance at which cts were visible during a London winter. First with regard to the shine experiments. One station is situated in the heart of the city, Bunhill Row, and it is of much interest to compare the amount of shine there with, first the amount in the immediate neighbourhood of don, where we are not beyond the effect of town fogs, viz., at enwich on one side and at Kew on the other, and also with a place not from London which is beyond the influence of its smoke, viz., Aspley se, near Woburn. I have also noted the results obtained at tbourne, which is about as far distant from London as Aspley Guise, in the opposite direction, and is one of the sunniest places in gland.

HOURS of SUNSHINE during the year 1890.

Month.	Bunhill Row.	Greenwich.	Kew.	Aspley Guise.	Eastbourne.
uary - -	29·9	44·0	56·0	57·3	56·9
ruary - - -	42·4	62·8	57·8	70·5	106·5
ch - -	71·3	90·8	109·3	110·4	133·5
il - - -	127·4	141·5	144·8	137·3	170·1
y - - -	215·7	223·9	223·9	214·3	267·9
e - - -	128·0	125·2	141·4	119·1	165·3
y - - -	134·1	120·6	139·9	141·3	185·6
gust - - -	164·0	153·1	182·5	189·5	200·2
tember - -	131·6	153·2	169·5	166·1	207·4
ober - - -	89·6	96·9	121·6	135·6	125·3
vember -	23·4	40·8	57·6	64·7	66·9
ember - -	0·1	2·4	0·3	13·4	38·0
Total - -	1157·5	1255·2	1404·6	1419·5	1723·6

Taking the totals of last year, the table shows that the hours of ashine registered at Bunhill Row was 1158, at Greenwich 1255, at ew 1405, at Aspley Guise 1420, and at Eastbourne 1724. But for r present purpose we must compare the amounts of sunshine at these

places during the winter months, November, December, January, and February, and we find that at Bunhill Row there were 95·5, Greenwich 150, Kew 171·7, Aspley Guise, 205·9 and at Eastbourne 268·3 hours of sunshine; that is, if Aspley Guise be taken as giving the normal proportion, Bunhill Row received only half its due amount, and at Eastbourne there was nearly three times as much sunshine as in the city. Now, on comparing the two other periods of four months which are comparatively free from fogs, the amount of sunshine is far more nearly equal at all stations.

—	Bunhill Row.	Greenwich.	Kew.	Aspley Guise.	Eastbourne
March till June -	542·4	581·4	619·4	581·1	736·8
July till October -	519·3	523·8	613·5	632·5	718·5

Mr. Raffles, during the winter of 1887–88, which it should be noted was remarkably free from fogs, made a series of observations of the distances to which he could see from Primrose Hill, and found that looking south on the 152 consecutive days from November to March only on 78 days could he see a quarter of a mile, and only on 83 days could he see to the same distance in a south-westerly direction. This conveys a good idea of the opacity of our London atmosphere.

We attempt to compensate for the darkness which fogs cause by the use of artificial light, and I have again to thank my friend Mr. Livesey for the information he has given me with regard to the extra quantity of gas burnt in London during a day of fog. He tells me that if a dense fog covered the whole of London and lasted all day, the additional amount of gas consumed would be 30 million cubic feet; but since so extensive a fog as this probably never exists and certainly never lasts all day, the actual amount consumed may be correctly reckoned at 25 million cubic feet; and, if the cost of this be calculated at 2*s.* 6*d.* per 1,000 cubic feet, which is rather below than above the actual cost, it amounts to 3,125*l.* But after all it is not the single days of dense fog that measure the extra amount and cost of artificial light used on account of fog; it is rather the continually occurring dull days and local transitory fogs which demand an extra supply of gas; and this is often 5 to 15 million cubic feet in a day, and gives a total by the end of the winter which is very considerable. As a standard of comparison I should state that the total consumption of gas in the London district in a day of 24 hours during the depth of winter is 140 million cubic feet.

Such then is an imperfect outline of the chief features and effects of town fogs; and now, what is to be said with regard to the possibility of getting rid of such fogs? This question, it seems to me, resolves itself into this; fogs cannot be prevented from forming over towns; there are, and probably ever will be, special inducements in the way of dust particles and products of combustion for fogs to form; but whether they must always be dark in colour and loaded with soot and

tarry matter is another question. The answer involves not only chemical but also social considerations. With regard to the first, my answer is, that as long as coal is burnt you will have dense fogs; grates, kitcheners, furnaces may be, and probably will be, much improved and fires may be stoked in a better way, but that the improvements will be so great that all imperfect combustion will cease I think is improbable. If this be so, there is only one other alternative, as long as coal is our source of heat, and it is to alter our form of fuel, to adopt gas and coke; the soot and tarry matters will be then done away with. The question of sulphuric acid in the air would remain, but our fogs would at least be white. There is still the social part of the question, which is not without serious difficulty, namely,—How to induce or to compel people to give up the use of coal? At the present day it would not be possible to do as it is recorded was done in the reign of Edward I.—try, condemn, and execute a man for burning coal in the city of London.

APPENDIX.

The Effects of Fog on Plants grown in the Houses at Kew. By W. Watson.

The heavy fogs experienced in the last two or three winters injured many plants in the houses at Kew. When thick fog occurred almost daily, the injury it did to many plants amounted practically to destruction. The leaves fell off, the growing point withered, and in some cases such as Begonias and Acanthads, the stems also were affected. Flowers as a rule fell off as they opened or whilst in bud. Almost all flowers which expanded were less in size than when there was no fog. The flower-buds of *Phalænopsis*, *Angræcum*, some Begonias, Camellias, &c., changed colour and fell off as if they had been dipped in hot water.

In the Palm House bushels of healthy-looking leaves which had fallen from the plants were gathered almost every morning. Plants which appeared to be perfectly healthy, when shaken would drop almost every leaf. Herbaceous plants suffered most; *e.g.*, Begonias, Poinsettias, Bourvardias, Acanthads, &c. Some herbaceous plants, however, did not suffer at all, nor were their flowers injured, as, for instance Cyclamen, Primula, Hyacinth, &c. Many hard-wooded plants lost their leaves and were otherwise damaged, viz., Boronias, some Heaths, Grevilleas, Acacias, &c. *Protea cynaroides*, a Cape plant with large laurel-like leaves, was much injured in the Temperate House (min. temp. 40°), the leaves turning black as though scalded. The same species, however, in another house where the atmosphere is drier and the temperature a few degrees higher, was scarcely affected by fog.

As a rule, the plants that were in active growth suffered most. Monocotyledonous plants and ferns for the most part were not appreciably affected by the fogs; the injury they suffered, especially last winter, being clearly due to low temperature. The effect of fog on flowers at Kew is remarkable. Generally white flowers are destroyed,

but there are some notable exceptions, viz., ***Masdavallia tovarensis***, ***Odontoglossum crispum***, and some ***Angræcums*** amongst orchids, and linums, white cyclamen, white hyacinths, white chrysanthemums, &c.

The green leaves of ***Poinsettia pulcherrima*** all fell off, whilst the red ones (bracts) remained, as also did the flowers. All Calanthes of whatever colour lost their flowers. The buds of the white-flowered ***Angræcum sesquepedale*** turned black as if boiled, whilst those of ***A. eburneum***, also white flowered, were not injured and developed properly. These two plants are grown in the same house, under identical conditions, and they come into bloom about the same time.

The conditions most conducive to rest from growth, viz., a low temperature and a moderately dry atmosphere, together with diminished light—unavoidable in foggy weather—were proved at Kew to be the safest for all plants during the prevalence of heavy fogs.

The Air of Large Towns: Methods of Analysis.

PRESENTED BY

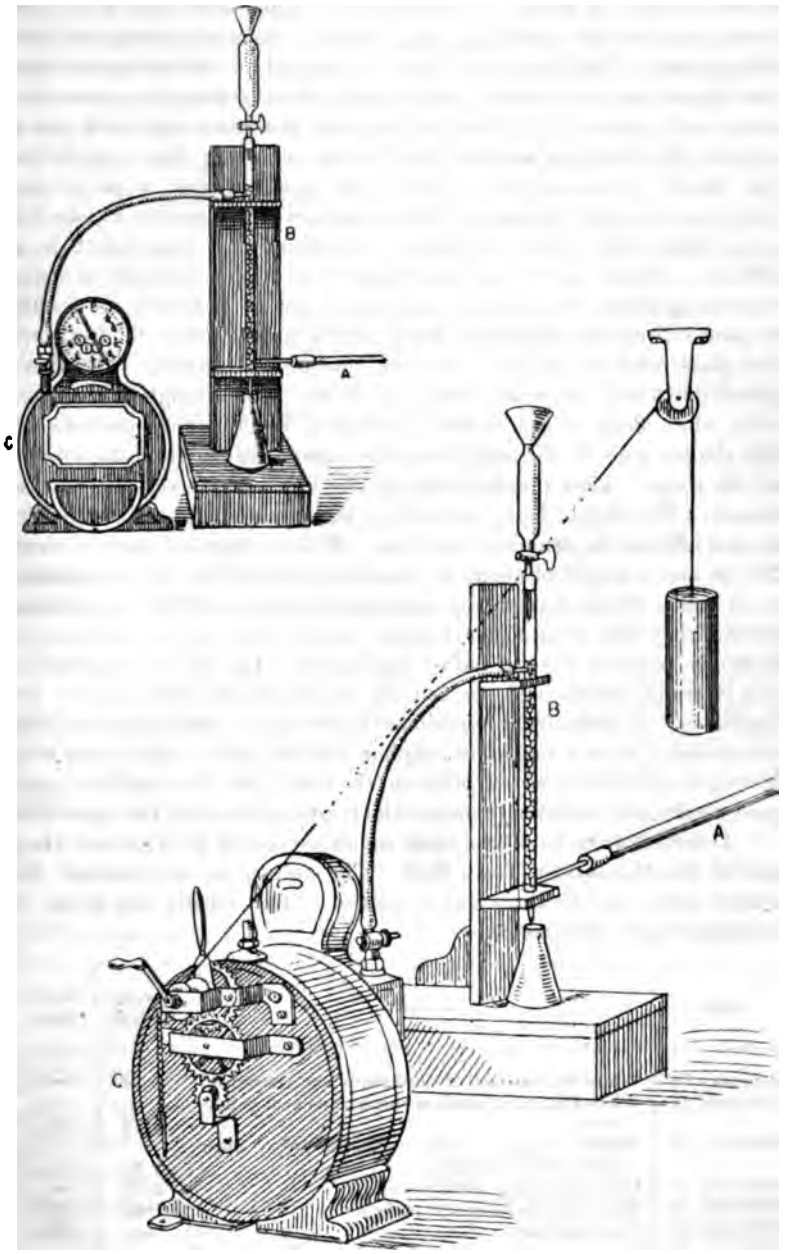
MR. HARTOG on behalf of the Air-analysis Committee of the Manchester Field Naturalists' Society, (Dr. BAILEY, Dr. J. B. COHEN, Mr. PHILIP HARTOG, and Dr. TATHAM.)

A general and systematic investigation is being made of the composition of the air of Manchester in the different parts of the city. Special attention is being paid to the following points: (*a*) The differences of composition in the air of thinly and of densely populated areas; (*b*) the relation between atmospheric impurity and prevalent sickness and mortality; (*c*) the extent to which smoke and noxious vapours are due to factories and to dwelling-houses respectively; (*d*) the character of the air during the prevalence of fog; (*e*) the relative amount of light in different districts.

The following paper contains a brief account of the preliminary results which have been obtained.

It was decided first of all to deal with the presence of sulphurous acid in the air, for the following reasons:—1. Sulphurous acid, and the sulphuric acid to which it gives rise by oxidation, are distinctly harmful, even in small quantities, both to animals and the higher plants. It seems probable that the effects of town fog are largely due to the excess of sulphurous acid which it contains. 2. We know definitely that the sulphurous acid of the air arises wholly and solely from the combustion of coal, which contains from 1 to 2 per cent. of sulphur. It is a pollution especially characteristic of our great cities, and is, in our opinion, a pollution which properly directed efforts may abolish. 3. The subject is one which has scarcely been touched by previous observers, owing to the difficulties of estimating sulphurous acid when it is largely

diluted with other gases, as in the atmosphere. We describe here a simple and accurate method which we have devised for its estimation.



The apparatus used consists of three parts—A, a long glass tube about half an inch in diameter, open at both ends, which is fixed horizontally so as to project into the open air; B, a glass tower about 30 ins. high and 1¼ ins. in diameter, open at the top, and drawn out

into a fine jet at the bottom. Two side tubes are fixed to the tower, one near the bottom and the other on the opposite side near the top. The tower is filled to within one inch of the upper side tube with glass beads, and into the open top a tap-funnel is inserted through a tightly fitting cork. The lower side tube is attached to the horizontal tube; the upper one by means of wide india-rubber tubing, to a combined meter and aspirator C. This is an ordinary wet-meter converted into an aspirator by attaching toothed wheels to the revolving drum and driving the wheels by means of a wire cord passing over a pulley and carrying a weight. A series of dials registers the volume in hundredths of a cubic foot. The method of conducting the experiment is as follows:—About 250 c.c. of a solution of hydrogen peroxide in water, containing about one milligram of active oxygen in each cubic centimetre, is poured into the tap-funnel, from which it is allowed to drop onto the glass beads at the rate of about one drop a second. The liquid passes down and out at the lower end of the tube through the jet, and falls into a flask placed below. A drop of liquid which permanently fills the jet seals it effectually from the entrance of air from the interior of the room. After running through, the liquid is poured back into the funnel. The weight being wound up, the volume indicated on the dial is read off, and the drum set in motion. With a column of beads of about 20 ins. and a weight of about 10 lbs., twenty cubic feet can be aspirated in an hour. Once started, the apparatus needs no further supervision until either the weight has reached the ground or the solution of hydrogen peroxide has run out of the funnel. The period required for this is readily determined, so that no time is lost in looking after the apparatus. A preliminary experiment made with an artificial atmosphere containing a known volume of sulphur dioxide, and a check tube with hydrogen peroxide inserted between the tower and the aspirator gave good results, and sufficiently proved the trustworthiness of the apparatus.

Determinations have been made simultaneously at the Owens College and at the Manchester Town Hall. The volume of air analysed has varied from one to three cubic metres. The results are given in milligrams per cubic metre:—

1891.	———	Owens College.	Town Hall.
February 18	White fog, no smell of sulphurous acid (morning)	3·14	—
February 18	White fog, slight smell of sulphurous acid (afternoon) - - - -	3·72	—
February 19	Slightly foggy at commencement only; clear rest of time (midday) - - -	1·95	—
February 19	Clear and sunny (afternoon) - -	2·10	—
February 19	Moonlight and clear (evening) - -	1·80	1·87
February 20	Clear (midday) - - - -	—	1·38
February 21	Clear (midday) - - - -	2·07	—
February 24	White fog and clear at close (midday) -	3 08	4·06
February 25	Clear and sunny (10 to 5)- - -	0·77	—
February 27	Foggy (9.30 to 12) - - - -	—	7·40
March 6	Very clear, wind (9.30 to 2.30) - -	0·28	—
March 12	Misty, bright sun (11.45 to 1.25) - -	0·97	—

The results show considerable variation in the amount of sulphur dioxide present in the atmosphere. The lowest result was obtained on March 6th, after two days' strong wind. The highest results were obtained on February 18th, 24th, and 27th, and on all these days there was a considerable amount of fog. The determinations made simultaneously at the Owens College and at the Town Hall show an excess of sulphur dioxide in the centre of the town.

Analyses of snow on successive days showed that during a three days' fog rather more than 1½ cwt. of sulphuric acid per square mile was deposited in the centre of the town; at an outlying station 1 cwt. of sulphuric acid and 13 cwt. of blacks per square mile was carried down during the same time.

The solid deposits on leaves of shrubs have also been analysed, and the results amply explain the difficulty experienced in growing plants and trees in towns. A series of observations on the clearness of the air, and on daylight intensity is also being made.

The organic matter in the air is to be estimated by a modification of the method used by Tidy in water-analysis. The committee adopts Dr. Russell's plan of collecting the dust, &c. by sucking a known quantity of air through glass wool, but instead of subjecting this wool to a combustion in oxygen, it is treated by dilute permanganate of potash, which is titrated back first immediately and then again after the lapse of a few hours.

An analysis was made of a deposit which was formed on plant-houses in London and supplied to the committee by the kindness of W. T. Thiselton Dyer, Esq., F.R.S., Director of Kew Gardens, and of Professor F. W. Oliver, of University College. It was found to contain:—

Carbon	39·00	per cent.
Hydrocarbons	12·30	„
Organic bases	2·00	„
Sulphuric acid	4·33	„
Hydrochloric acid	1·43	„
Ammonia	1·37	„
Metallic iron and magnetic oxide	2·63	„
Other mineral matter, chiefly silica and ferric oxide	31·24	„
Water (not determined)	—	

The committee is working in concert with a committee of the Royal Horticultural Society in London; and during the coming winter, with the aid of a grant from the Royal Society, experiments in Manchester and in the Metropolis will be carried on simultaneously.

DISCUSSION.

Dr. C. Theodore Williams pointed out the difficulty of determining how far the injurious effects observed in times of fog were due to the fog itself, or to the cold usually accompanying it. London fog was often fatal to people in a precarious state of health or suffering from advanced disease. With the majority it was not so, although it gave rise to various complaints that were not necessarily fatal. Fog induced thirst, smarting of the eyes, headache, coryza, bronchial catarrh, pharyngitis, bronchitis, and occassionally pneumonia. A prolonged period of fog also caused pallor and anæmia in a certain number of persons. He had noted that during the quarter ending March 31st, 1891, which had been a very foggy one, the Registrar-General's returns showed the mortality under one year of life to be 2·1 per cent. above the average of 20 years, and that of people over 60 to be 9·5 per cent. above the average; but the mortality of the population between one and 60 years of age to be 2·6 per cent. below the average, and this in spite of great cold and fog. He had observed cases of asthma in which the patient was benefited by a London fog, and even by the atmosphere of the Underground Railway.

Mr. Ernest Hart said that he was sure that Dr. Williams did not mean to imply that his experience of a few subjects of a disease so capricious as asthma had any general value. To create or tolerate London fogs for the sake of a few asthmatics, would be to burn down the house for the sake of roasting the pig. The mortality of London during the previous great fogs had been as great as in a cholera season. He enumerated a number of examples of the methods by which smoke might be diminished in private houses; the latter were the main sources of smoke in towns, and they affected not only the purity of air, but the amount of light, so that all London, Manchester, Sheffield, Wolverhampton, and other large towns were now, during a large part of the year, gigantic cellar dwellings. Mr. Hart mentioned the legislation suggested by the Smoke Abatement Society and approved by many local authorities, as well as by a Committee of the House of Lords.

Dr. Tripe (Hackney) agreed with Mr. Hart. In Hackney, as soon as the fogs set in, mortality increased, the effect of the fogs being to kill off those who were susceptible. Many asthmatics received quite as much benefit from breathing hydrocarbons as from a London fog.

Dr. Edward Haughton thought that there was urgent need of legislation in relation to smoke abatement, and considered that a small house tax should be imposed upon those who neglected to use grates of a proper construction. He regarded as sufficient the change recommended 90 years ago by Count Rumford, viz., the substitution as far as possible of closed grates for open ones, as the latter waste six-sevenths of the heat that is generated, besides loading the atmosphere with sulphurous acid and unconsumed carbon. The public must take the matter into their own hands and demand that their representatives should work for this reform.

Professor F. W. Oliver (Kew Gardens) drew attention to the nature and extent of the injuries caused by fog to vegetation, and gave an account of some experiments on this subject carried out under the

auspices of the Scientific Committee of the Royal Horticultural Society. He alluded in some detail to the action of sulphurous acid on vegetable protoplasm. In conclusion he referred to the work of the Manchester committee, and expressed the conviction that similar systematic records should be kept of the varying constitution of the London atmosphere.

Mr. Pridgen Teale, speaking of domestic smoke as the result of imperfect combustion, said that this could be in a great measure reduced by adopting in our fireplaces principles of construction now well understood, but violated in a large proportion of the grates produced by makers. Coal must be burned in as hot a grate as possible, viz., fire-brick, and the air should be admitted on the surface of the coal not through it, coal being burned in so large a mass as is consistent with the size of the room to be warmed.

Professor K. B. Lehmann (Würzburg), sagte:—Wir haben weniger Russ in unserer Stadtluft, aber unter schwefliger Säure leiden auch wir in Deutschland. Ich erlaube mir an die interessanten Untersuchungen zu erinnern, welche Sendtner auf Veranlassung von Pettenkofer unternommen hat. Dieselben ergaben ausser der Bestätigung einer Reihe der heute gehörten hochinteressanten Thatsachen, dass namentlich auch Statuen aus Marmor und Bronce stark unter schwefliger Säure leiden und dass letztere keine Patina ansetzen, sondern nur schwarz und rauh werden. Diese Thatsache ist für Kunststädte nicht ohne Bedeutung, wenn natürlich von weit geringerer als die hygienische. Letztere wurde von Ogata und L. Pfeiffer im Laboratorium von Pettenkofer sorgfältig durch Thierversuche studiert.

Mr. B. H. Thwaite (Liverpool) said that several years' experience had satisfied him that the cause of the black and noxious fogs of large towns was the presence in the atmosphere of the volatile hydrocarbons and the sulphurous acid resulting from the imperfect combustion of bituminous fuel. The presence of these constituents, by interference with the solar heat and light, produced the lowering of temperature and the reduction of chemical effect of the solar rays in regard to organic life. He suggested for the metropolis the conveying of gas under high pressure from the coal districts in steel tubes; the London County Council to supply such gas to the inhabitants at a reasonable price, and thus to initiate successful municipal procedure in the provinces.

Mr. Hargreaves Raffles advocated the collection and comparison of statistics relating to town fogs from all large cities.

The following *Resolution* was moved by the President, and seconded by Mr. Ernest Hart:—

> "That the Section of Chemistry and Physics in relation to Hygiene requests the President of the Local Government Board and the Home Secretary to take into consideration whether legislative measures cannot be adopted to lessen the amount of smoke produced from dwelling houses, and thus to diminish the intensity and mitigate the evil effects of town fogs."

This resolution was carried unanimously.

The Means at our disposal for Preventing the Emission of Smoke from Factories and from Dwelling Houses.

BY

ALFRED E. FLETCHER, F.I.C., &c., H.M.'s Chief Inspector under the Alkali, &c. Works Regulation Act.

The complaints that have been raised against the black smoke arising from the combustion of coal are not of yesterday. Nearly six centuries ago there was a cry in London that such a nuisance was not to be endured, and a royal edict was issued by King Edward II. in the year 1316 that coal-burning should cease, and that if any self-willed citizen should continue the obnoxious practice, and still contaminate the air with that foul vapour, his house should be pulled down about his ears.

This peremptory order for a time sufficed to stop the objectionable practice of burning smoky coal, but how long its effect lasted it is difficult to determine. It would appear that the increasing scarcity of wood, and the excellency of coal as a fuel, forced the latter again into use in spite of king and commons, for, in later times, we find Parliament petitioning the King to issue an edict to stop the burning of coal, which had again come into use. Smoke, however, seems to have held its own in spite of all attempts at repression, although fresh efforts were continually made in that direction.

In the year 1829 a select committee of the House of Commons was appointed to inquire into the effect of the smoke from factory chimneys on the public health; and, in 1843, another committee was appointed to consider the "means and expediency of preventing the nuisance of smoke." No definite result is recorded.

Ten years later a determined step was taken by Lord Palmerston, then Prime Minister. He introduced a Bill making it penal to allow black smoke to issue from any factory chimney within the metropolis or from any steam vessel plying on the Thames above London Bridge. The fines imposed were heavy and cumulative. The Act is that of 1853 (16 & 17 Vict. c. 128).

In 1856 this was followed by an amending Act extending the prohibition of smoke to all steam vessels plying below London Bridge as far as the Nore, and including bakehouses and certain factories which had been kept out of the former Act.

A marked benefit was at once felt from the operation of these Acts. Steamboats on the Thames had been accustomed to vomit out huge volumes of smoke wholly out of proportion to their size; and factory chimneys in the eastern districts of London had filled the air with blackness. Now all was changed; these chimneys seemed to keep perpetual holiday, though, indeed, the fires beneath them were never brighter, while Old Father Thames passed on his way under clearer air,

and the gardens at the Temple and elsewhere on his banks rejoiced in flowers and shrubs hitherto impossible in the smoke-laden atmosphere.

The air of London was relieved of nearly all the smoke of factory chimneys by the operation of these Acts; but the smoke from dwelling-houses remained. In the foggy weather of winter the great evils arising from this latter source are so painfully brought to the knowledge of every Londoner that he is unconscious of the relief he has gained by the operation of Lord Palmerston's Factory Smoke Acts.

The administration of the Acts is placed in the hands of the Metropolitan Police, under the control of the Home Office. In this, London is distinguished from other parts of the country. Generally, the administration of the smoke clauses of the Health Act of 1875 are in the hands of the magistrates or other local sanitary authority; and, as these are often the principal offenders, it is not surprising that excuses are found for allowing the law to remain in abeyance.

The black smoke which rises from a coal fire consists of the volatile matter which is given off under the influence of heat and yet has escaped combustion. When combustion is complete no visible smoke is discharged; the escaping gas consists then only of carbonic acid and vapour of water or steam, together with some sulphurous acid resulting from the burning of the sulphur pyrites in the coal.

Visible smoke is the result of an imperfect combustion. The gaseous matter set free when coal is heated consists of various compounds of hydrogen and carbon; when these are burned with a quantity of air insufficient to inflame the whole, the hydrogen only is burnt, while the carbon remains in the form of the black matter or soot with which we are too familiar. This black residue is made apparent also when the combustion is rendered incomplete by deficiency of heat, even if there is a sufficiency of air or oxygen—as may be shown by introducing a piece of stout copper wire into the flame of a clear-burning wax candle. The cold wire diminishes the temperature of the flame, and, rendering the combustion incomplete, causes the formation of soot, part of which is deposited on the cold wire and part rises in smoke from the top of the flame. Or, again, combustion may be rendered incomplete if sufficient time be not allowed for the due mixing of the combustible gas with the air. There must be intimate mixture, so as to promote contact between the air and every particle of the gas to be burned.

There are, then, three conditions to be observed in order to effect the complete combustion of the gaseous mixture given off from strongly heated coal:—First, there must be sufficient air; second, the air must be mixed with the gas; third, this mixture must be raised to the temperature of ignition.

It may be necessary to dwell briefly on this last head, and to observe that the temperature of ignition varies with different substances. The temperature at which sulphur will ignite is much below that at which carbon will burn. Pure hydrogen also will ignite at a lower temperature than is necessary for hydrocarbons. These and the other gases which form the mixture given off on heating a bituminous coal require a heat approaching that of whiteness to ignite them.

Now if these three conditions for the combustion of coal gas be all observed the burning will be effected, but if the observance of any one of them be omitted complete ignition will not take place.

It may be said that in most furnace fires the first condition is fulfilled, except at the time when fresh fuel is put on. When a bituminous coal is thrown onto a hot fire a large volume of gas is suddenly generated; this fills for a time the draught passages, so that just when an increased supply of air is needed less air than usual finds access to the fire.

A very common cause of failure arises from a non-observance of the second condition necessary to complete combustion. The air, though admitted both above and below the fire, never mixes with the gases thrown off from it, but passes with them in parallel streams till they reach a place where the temperature is so low that ignition is no longer possible.

In the furnaces of steam boilers a very common cause of failure in combustion is the non-observance of the third condition. The gases rising from the fire, and mixed perhaps with the air needed for burning them, are in many cases hurried from the immediate neighbourhood of the fire, where alone a sufficiently high temperature is found, to the boiler flues, where, deprived of their heat, all combustion is impossible. This is especially the case in a so-called haystack boiler, often used on river steamboats, and very commonly on the Clyde. There the fuel gases rising from the fire are at once led through cold tubes surrounded by water. In such a case combustion, if commenced, is stopped and rendered impossible from want of heat, and the unburnt gases laden with soot pass on to the chimney.

Of the fuel used in manufacturing operations about two-thirds is employed for raising steam. It is necessary, therefore, in considering the problem of smoke prevention to direct special attention to the construction of the furnaces of steam boilers. The three conditions already shown to be necessary to complete combustion must be observed, and, beyond these, it is necessary to avoid as far as possible the admission of an excess of air if the maximum duty of the fuel is to be realised.

When a furnace is fed by hand the operations of stoking must necessarily be intermittent, and consequently the due proportion between the fuel and the air cannot be constantly maintained. The necessity also of opening the fire-door is a constant source of loss, in that an excess of cold air is drawn in which tends to cool the boiler. There is evidently then a danger, on the one hand, of supplying too little air and so causing the formation of black smoke, or on the other hand of supplying too much and so causing a loss of heat.

In order to ascertain the general composition of fuel gases passing as smoke up factory chimneys I made a series of experiments in 1888, analysing the gases from furnaces in Newcastle and in Lancashire, where different kinds of coal were used. The annexed table shows the results of the analyses. It will be seen that in all cases but one there was a very large excess of air, even when black smoke was emitted. The

Analyses of Chimney Gases.

Number.	Name of Firm.	Description of Furnace.	Remarks.	Smoky.						Slight Smoke.						Clear.					
				N	O	CO_2	CO	CH_4	H	N	O	CO_2	CO	CH_4	H	N	O	CO_2	CO	CH_4	H
			Hand Fired Furnaces.																		
1	Brunner, Mond & Co. -	Lancashire boiler -	Before and after stoking -	80·65	8·6	10·25	·5	0	0	—	—	—	—	—	—	80·0	9·75	10·25	0	0	0
2	Copley & Co., Middlesbro'	Marine boiler -	S. Durham coal. Eldon nuts.	82·78	1·72	15·0	0·5	0	0	—	—	—	—	—	—	79·92	15·68	4·4	0	0	0
3	Dorman, Long. & Co. do.	Lancashire boiler -	Large Trindon coal -	79·75	18·75	1·5	[illegible]	0	0	—	—	—	—	—	—	80·25	18·50	1·25	0	0	0
4	" " - -	" " -	" " - -	—	—	—	—	—	—	—	—	—	—	—	—	80·0	19·70	0·3	0	0	0
5	" " - -	" " -	" " - -	—	—	—	—	—		—	—	—	—	—	—	83·55	8·65	7·8	0	0	0
6	Eureka Salt Co., Northwich.	Lancashire boiler -	Steam jet used when stoking.	—	—	—	—	—		—	—	—	—	—	—	79·85	14·65	5·5	0	0	0
7	Eureka Salt Co., Northwich.	" " -	Steam jet used when stoking.	—	—	—	—	—		—	—	—	—	—	—	80·55	9·45	10·0	0	0	0
8	Eureka Salt Co., Northwich.	" " -	After stoking without steam jet.	—	—	—	—	—		80·75	·45	8·8	0	0	0	—	—	—	—	—	—
9	Eureka Salt Co., Northwich.	" " -	After stoking without steam jet.	—	—	—	—	—		81·5	9·45	9·05	0	0		—	—	—	—	—	—
10	Musgrave Atlas Mills, Bolton.	Lancashire boiler -	18 tons of coal a week of 60 hours.	—	—	—	—	—		81·8	8·65	9·55	0	0		80·75	12·7	6·55	0	0	0
11	Musgrave Atlas Mills, Bolton.	" " -	18 tons of coal a week of 60 hours.	—	—	—	—	—		81·25	10·70	8·05	0			—	—	—	—	—	—
12	N.E. Steel Co., Middlesbro'	Lancashire boiler -	Durham coal - -	82·95	3·5	13·25	0·05	0·25	0	—	—	—	—			80·75	8·4	10·85	0	0	0
13	Tharsis Copper Co., Newcastle.	Lancashire boiler -	Small coal. Before and after stoking.	80·5	14·3	5·2	0	0	0	—	—	—	—			80·15	15·20	·65	0	0	0
14	Newcastle Chemical Co., Salt Works.	Fire under salt pan	Small coal - - -	—	—	—	—	—		—	—					79·55	18·45	2·0	0	0	0
15	Newcastle Chemical Co., Salt Works.	" " -	" - - -	—	—	—	—	—		—	—					79·75	18·40	·85	0	0	0

Analyses of Chimney Gases—*continued.*

Number.	Name of Firm.	Description of Furnace.	Remarks.	Smoky.						Slight Smoke.						Clear.					
				N	O	CO_2	CO	CH_4	H	N	O	CO_2	CO	CH_4	H	N	O	CO_2	CO	CH_4	H
16	Friar's Goose Chemical Co.	Sulphate roaster furnace.	Small coal. Before and after firing.	82·42	2·15	14·85	0·25	0	0·33	—	—	—	—	—	—	82·75	2·4	14·85	0	0	0
17	Kurtz & Co., St. Helens	Fire under caustic pot.	Before and after firing	81·80	7·50	10·25	0·45	0	0	81·15	8·75	9·5	0·5	0·1	0	—	—	—	—		
18	N.E. Steel Co., Middlesbro'	Heating furnace	Durham coal	—	—	—	—	—	—	—	—	—	—	—	—	83·55	8·65	7·8	—	0	0
19	Newcastle Chemical Co.	Fire under caustic pot.	Small coal. After firing	81·95	4·45	10·35	2·35	0·75	0·15	—	—	—	—	—	—	—	—	—	—		
20	Thos. Rayner, Northwich	Fire under salt pan	Four fires to pan	80·3	12·75	6·75	0·2	0	0	80·25	13·55	6·2	0	0	0	—	—	—			
21	Sadler & Co., Middlesbro'	Fire under caustic pot.	Small coal. Before and after firing.	80·82	1·3	10·95	3·0	0·70	3·23	—	—	—	—	—	—	84·0	8·25	7·75	0	0	0
22	Tharsis Copper Co., Newcastle.	Calcining furnace	Small coal. Before and after firing.	80·25	10·0	9·0	0·75	0	0	80·75	10·25	9·0	0	0	0	80·75	12·90	6·35	0	0	0
23	A. J. Thompson, Northwich.	Fire under salt pan	Small coal. Before and after firing.	80·2	16·3	3·5	0	0	0	—	—	—	—	—	—	80·0	17·0	3·0	0	0	0
24	Bass & Co., Burton	Lownd's hollow bridges.	Before and after firing	—	—	—	—	—	—	80·9	8·35	9·85	0	0	0	80·35	12·8	6·85	0	0	
25	Dacca Twist Mills, Manchester.	Holden's hollow bars	Before and after firing	—	—	—	—	—	—	80·85	8·9	10·25	0	0	0	79·7	15·55	4·75		0	0
26	Dacca Twist Mills, Manchester.	" "	" "	—	—	—	—	—	—	82·25	5·05	12·7	0	0	0	—	—	—			
27	Eureka Salt Co., Northwich.	Higgins' patent blast draught.	Before and after firing	80·35 80·25	14·90 16·40	4·75 3·35	0 0	0 0	0 0	— —	— —	— —	— —	— —	— —	80·05 79·95	16·7 16·55	3·25 3·5	0 0	0 0	0 0
28	J. C. Gamble & Son, St. Helens.	Sliding door to fire, open when stoking, and closing gradually (3 mins. to shut).	Before and after firing	—	—	—	—	—	—	81·3	9·55	9·15	0	0	0	81·0	11·75	7·25	0	0	0
29	J. Schofield, Littleborough	Finch's furnace	Ordinary condition. Large coal.	—	—	—	—	—	—	—	—	—	—	—	—	80·8	13·9	5·3	0	0	0

Analyses of Chimney Gases—*continued.*

Number.	Name of Firm.	Description of Furnace.	Remarks.	Smoky.						Slight Smoke.						Clear.					
				N	O	CO_2	CO	CH_4	H	N	O	CO_2	CO	CH_4	H	N	O	CO_2	CO	CH_4	H
30	J. Schofield, Littleborough	Finch's furnace -	Ordinary condition. Large coal.	—	—	—	—	—	—	—	—	—	—	—	—	80·75	13·5	5·75	0	0	0
31	J. & E. Stott, Flixton -	Harlow's hollow bars.	After stoking - -	—	—	—	—	—	—	81·0	10·75	8·25	0	0	0	—	—	—	—	—	—
32	" " -	Harlow's hollow bars.	Before stoking - -	—	—	—	—	—	—	79·5	15·25	5·25	0	0	0	—	—	—	—	—	—
33	Sutton Lodge Chemical Co., St. Helens.	Fire under caustic pot.	Slanting fire bars. Do. -	79·03	11·1	7·05	1·35	0·45	0·12	—	—	—	—	—	—	80·75	13·65	5·6	0	0	0
34	Sutton Lodge Chemical Co., St. Helens.	Fire under caustic pot.	" " -	—	—	—	—	—	—	—	—	—	—	—	—	80·3	15·05	4·65	0	0	0
35	Talbot Mills, Manchester	Split bridge, 3 boilers.	Before and after stoking -	—	—	—	—	—	—	80·25	14·6	5·15	0	0	0	79·75	16·0	4·25	0	0	0
36	Wardle & Brown, Bolton	Split bridge, inlet of air controlled by door.	18 tons coal a week. No smoke usually.	79·6	7·00	8·75	3·25	0·40	1·00	81·25	8·4	10·35	0	0	0	80·85	11·4	7·75	0	0	0
			Mechanical Stokers.																		
37	John Bayley & Son, Bolton.	Vicars stoker - -	3½ tons coal in 10 hours -	—	—	—	—	—	—	—	—	—	—	—	—	80·75	12·0	7·25	0	0	0
38	Canon Bros., Bolton -	Jukes stoker -	22 tons a week of 60 hours	—	—	—	—	—	—	80·1	14·65	5·25	0	0	0	—	—	—	—	—	—
39	Crook & Son, Bolton -	Sinclair stoker -		—	—	—	—	—	—	89·75	11·0	8·25	0	0	0	—	—	—	—	—	—
40	Crosses and Winkworth, Bolton.	Bennis stoker - -	20 tons coal a week - -	—	—	—	—	—	—	80·25	13·9	5·85	0	0	0	80·35	14·4	5·25	0	0	0
41	Farnworth Bridge, Bolton	Cass stoker - -	Fire in ordinary condition	—	—	—	—	—	—	—	—	—	—	—	—	80·25	13·50	6·25	0	0	0
42	" "	" " - -	- - - -	—	—	—	—	—	—	—	—	—	—	—	—	81·10	7·35	11·65	0	0	0
43	" "	" " - -	- - - -	—	—	—	—	—	—	—	—	—	—	—	—	80·70	12·15	7·15	0	0	0

Analyses of Chimney Gases—*continued.*

Number.	Name of Firm.	Description of Furnace.	Remarks.	Smoky.						Slight Smoke.						Clear.					
				N	O	CO_2	CO	CH_4	H	N	O	CO_2	CO	CH_4	H	N	O	CO_2	CO	CH_4	H
44	Gossage & Co., Widnes -	Bennis stoker -	Fire in ordinary condition	—	—	—	—	—	—	—	—	—	—	—	—	80·75	11·1	8·15	0	0	0
45	" " -	Vicars stoker -	" Temp. of flue gases 380° F	—	—	—	—	—	—	—	—	—	—	—	—	80·45	12·95	6·6	0	0	0
46	Musgrave, Bolton -	Vicars stoker -	18 tons coal a week of 60 hours.	—	—	—	—	—	—	—	—	—	—	—	—	79·7	19·3	1·0	0	0	0
47	" " - -	Hodgkinson's sprinklers.	Ordinary condition - -	—	—	—	—	—	—	—	—	—	—	—	—	80·35	16·4	3·25	0	0	0
48	Peter Spence & Son, Manchester.	McDougal stoker -	" " - -	—	—	—	—	—	—	—	—	—	—	—	—	80·35	12·45	7·2	0	0	0
49	Brunner, Mond, & Co., Northwich.	Lancashire boiler -	Fired by producer gas -	—	—	—	—	—	—	—	—	—	—	—	—	82·00	0·45	17·30	0	0·25	0
50	Outram, Greetland -	" " -	Fired by Thwaites' producer gas.	—	—	—	—	—	—	—	—	—	—	—	—	80·00	11·15	8·25	0	0	0
51	" " - -	" " -	" " "	—	—	—	—	—	—	—	—	—	—	—	—	80·00	13·00	7·00	0	0	0
52	" " - -	" " -	" " "	—	—	—	—	—	—	—	—	—	—	—	—	79·80	13·70	6·50	0	0	0

exception was where gaseous fuel was used; here the balance was very nearly maintained, neither ogygen nor combustible gases being in excess.

In order to avoid the evils inherent to hand-stoking, to render the supply of coal more constant, and to keep the fire in a more uniform condition, many mechanical appliances have been adopted. In some of these the coal is continually thrown or sprinkled on to the fire in small quantities, in others it is pushed in at the front and worked back by movement of the bars till the clinkers are discharged under the bridge. A great many patents have been taken out for the various modifications of these machines, and for methods of conducting the combustion of coal in furnaces economically without the production of smoke. Some of these appliances are expensive to erect, and some have proved very expensive in use, the cost of maintenance being excessive, while some, on the other hand, effect a saving of labour and of fuel. In order, therefore, to ascertain the relative merits of all the various appliances offered with a view to economise fuel, and to prevent the discharge of smoke, a co-operative manufacturers' association* has been formed for testing practically all the principal smoke-preventing appliances found in general use, reporting on their first cost, the cost for repairs, and the comsumption of fuel in proportion both to the work done and to the amount of boiler space provided. When this report is published it will afford a valuable guide to all those manufacturers who desire to prevent the discharge of black smoke from their chimneys and to obtain the utmost efficiency from their boilers and from the fuel they consume.

One method now largely employed for effecting the complete combustion of fuel, and for preventing the discharge of black smoke, is that of converting the coal into gas and employing it in the furnace in place of solid fuel. This is done by burning the coal in a gas-producer. A limited portion of air only is admitted, so that the fue is carried off as a gas consisting of a mixture of carbon monoxide and hydrocarbons. If steam is admitted, it is decomposed by the incandescent carbon. In this operation of gas production about one-third the heat of the fuel is lost at the producer, and unless some corresponding advantage sufficient to compensate for this expenditure can be gained, the process is not economical. In many cases, convenience of application and the opportunity of saving in regenerators some of the heat justify the initial loss; in great measure it may also be recouped by so treating the gas as to separate the tar and ammonia formed in its generation. Where this is done, or where in any other way the employment of gas can be made economical, its use as a fuel is greatly to be desired as a means of preventing the emission of black smoke. Its use is particularly to be recommended in furnace fires, where a reducing atmosphere is needed, as in iron-heating furnaces. In such cases the gas may be made largely to consist of carbon monoxide and hydrogen; these, being kept in

* The Secretary of the Association is Mr. Fred. Scott, 44, John Dalton Street, Manchester.

excess of the air supplied for combustion, will afford a reducing atmosphere in the furnace, and will burn as it escapes either through the door or the chimney with a smokeless flame.

It may be confidently asserted that by the observance of the principles here laid down, and by the adoption of appliances now in frequent use, the economical use of bituminous coal as a fuel may be conducted without the discharge of black smoke.

House Smoke.—Thus far attention has been drawn to the prevention of black smoke from manufacturing operations. In many of our densely-peopled cities, however, the house chimneys contribute more to the pollution of the air than do those of factory furnaces.

Many attempts have been made by introducing close stoves or modifications of our fire-grates to prevent the emission of smoke, but our preference for the open fire, in which a flaming coal is burnt, is so determined that it would seem that smoke is inevitable. Sir Douglas Galton has done good service by devising a form of open grate in which a supply of air is so introduced as to assist greatly in the combustion of the smoke that would otherwise have escaped. Still there *is* smoke, and that, coming as it does from a thousand chimneys, forms a mighty cloud and an enormous pollution of the atmosphere. One further suggestion may, however, perhaps be made, for at any rate largely diminishing this discharge of smoke while still retaining the open fire.

Let a hot-air stove, burning coke or anthracite, be placed in the basement of the house, and a copious supply of warm, but not overheated, air be thrown into the passages and rooms. This has the effect of adding so much to the general comfort of the house that the demand on the separate fires is greatly diminished, less coal is burnt in them, and less smoke is therefore given off. The air, before coming to the stove to be warmed, should be led through a large filter-sheet of cotton wool or other fibrous matter, to collect the dust and smut. It is then not likely to convey the burnt or charred smell which arises from the scorching of the small pieces of fibre and organic matter generally to be found floating in it. As every chimney from the open fires is carrying up a large quantity of air, this air must be supplied to the house through some channel. Usually this is done by the leakages at window or door, causing unpleasant draughts; or at night, when all is close shut, this supply of air enters down the unused chimneys, bringing the damp and cold air from outside into the bedrooms, and with it a strong and most unwholesome smell of soot. All these evils are avoided by the admission of a copious stream of warmed filtered air into the house through a channel properly provided for it.

The use of gas as a smokeless fuel is largely to be recommended as a means of diminishing the production of smoke; its employment for cooking, heating of water for baths, &c. cannot be too warmly advocated, and also its largely-extended use for heating our rooms, while the general warmth of the house is maintained by a central hot-air stove.

A supply of cheap gas, and its liberal use as fuel in dwelling-houses, together with the adoption of coke-fed hot-air stoves in the

basement of houses, will, I think, be found the most effectual cure for the great plague of town smoke. Where this system is adopted, the present open fires, to which we are so much attached, may remain, but their use will be greatly diminished, while our comfort both in and out of our houses will be largely increased. Seeing that by this system the carrying of coals about the house, the removal of ashes, and the daily cleaning of fire-grates would be much lessened, the use of gas as a fuel can be recommended for its economy as well as for its cleanliness.

DISCUSSION.

The Mayor of Manchester **(Alderman John Mark)** said that there was now very much less smoke in Manchester than was the case some years ago. Many efforts had been made to improve matters, but improvement had been effected mainly in manufactories. The Manchester authorities had offered special facilities to the inhabitants to burn gas for heating purposes.

Mr. Courtney (Chelsea) stated that he had in use a hand-fired furnace in which, by careful attention to the relative quantities of air and coal employed, no smoke was produced; and invited members of the section to inspect it.

Demonstration of the possibility of removing the Smoke of Fires from the Air of Towns and of using it for Disinfecting Sewers.

BY

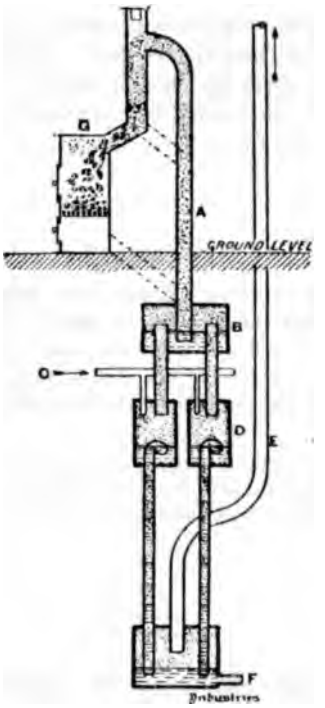
Dr. Sheridan Delépine and Mr. Alfred B. Gomess.

By means of a small quantity of water falling from a moderate height (a few feet) it is possible to produce a displacement of a large amount of air and to divert the smoke of a fire from a chimney into a system of pipes running in any direction.

By a very simple combination of channels and chambers the most fluid parts of the sewage may be used for the purpose of displacing the smoke and causing it to mix with the sewage (wherever a proper fall can be obtained by taking advantage of a natural disposition of the ground, or by raising the sewage artificially). Any supply of water could also be used for the same purpose.

A working model was shown by means of which the smoke of a fire could be carried by, and mixed with, water to any distance from and to any level below that of the fire.

The following is a brief description of the apparatus as shown in model form in the accompanying illustration.



SECTIONAL VIEW OF MODEL.

A stove G, in which turpentine is burnt, serves as the source of smoke, the stove chimney being capped so that no smoke can escape in the ordinary way. From the stove a descending flue A, communicating with the chimney and ending in a valve B, leads to the sewer. The object of the valve is to prevent any regurgitation of sewer gases when the apparatus is not at work. A number of jet pumps or exhausters D are connected with the flue or valve in such a way that a large amount of air can be displaced under low pressure by a small amount of water. The water pumps used have been specially devised for this purpose by Dr. Sheridan Delépine, and are based on the mode of action of intermittent siphons. The construction of the pump is such that a fall of only a few inches of water is sufficient to ensure a rapid removal of the smoke-laden atmosphere, and the authors point out that the same water can be used again and again provided the difference in level between one set of pumps and the other is at least 4 ft. or 5 ft. Owing to the difference of level existing between the various parts of a system of sewers, it would be possible to use filtered sewage as a source of power, and thus introduce at the same time into the sewage some of the numerous disinfectant products contained in the smoke. In this

way decomposition of the sewage would be retarded, and its value as a manure would be increased.

[NOTE.—The apparatus exhibited and represented diagrammatically above was only an experimental one, the object being to show the principle of the method as schematically as possible. E represents a ventilating shaft, and F an outlet (for the water charged with soot and other products) connected with a separating chamber, of which a series has to be used.]

Wednesday, 12th August 1891.

The President, Sir H. ROSCOE, in the Chair.

The Chemical Treatment of Sewage, with special reference to the Treatment of the London Sewage.*

BY

A. DUPRÉ, Ph.D., F.R.S.

Sewage must, in the first place, be looked upon as a material to be got rid of without injury to the population, and with the minimum amount of nuisance, without reference to any profit that might be derived from it.

The solution of the problem as to which is the best method of sewage disposal is so complicated, owing to the different conditions obtaining in different towns, that no general plan can, or should, be laid down, but each case must be treated on its own merits.

Of two plans for the disposal of sewage, both equally effective, the cheaper should be adopted.

CHEMICAL TREATMENT.—Many processes for the chemical treatment of sewage have been brought forward; but, excluding the proposed electrical treatment of sewage, which has not yet passed its period of probation, and the action of permanganate, of which more later, they may all be said to depend on the action of certain salts of alumina and iron, with or without the use of caustic lime.

The main effect of such chemical treatment is the more or less complete clarification of sewage, together with the removal of a certain proportion, generally a small one, of matters held in solution.

The character of the effluent, in some measure, depends on the condition of the sewage. Fresh sewage yields a better effluent than foul sewage; consequent necessity of some further treatment.

* This is the Abstract of a Paper which, owing to the Author's illness, could not be prepared for the Congress in full.

London Sewage.—*Difficulty of the Problem.*—Excessive volume of sewage to be dealt with. Size of area whence it comes, and consequent length of sewers, and foulness of sewage when it arrives at the outfalls. *System of London Sewerage.*—Collecting sewage proper and the rain-water in one system of sewers. Unsuitability of land in the neighbourhood, for sewage-farming, distance from the sea. *Solution of the Problem,* as attempted by the late Metropolitan Board of Works. Chemical processes clarify, but do not remove much dissolved matter. Evil effects of excess of chemicals used. Consequent use of minimum amount of chemicals capable of clarifying the sewage. The clarified sewage deodorised by manganate and sulphuric acid. Resulting effluent, inodorous and nearly clear, discharged into the river mainly during ebb tide. Portion of the river should be regarded as a sewage-farm, does its work in smaller area, as effectively and with far less nuisance than a sewage-farm proper. Destruction of sewage in river and on farm due to living organisms, but oxygen necessary. The River Thames capable of dealing effectively with the effluent. Consideration shows that the river will be adequate to deal with effluent for some time to come. This period can be prolonged by the proper use of manganate. Beneficial effects on river of proposed treatment of sewage greater than the mere removal of suspended matter would seem to indicate. Destruction of dissolved matter goes on more or less all the year round. Destruction of suspended matter greatly retarded during cold weather, and nearly the whole year's production has to be destroyed during summer.

Summary.—The plan adopted is far the cheapest. It will dispose of the London sewage, without nuisance, until London has increased to from 8,000,000 to 10,000,000 inhabitants.

When that time arrives, only the sewage in excess of the quantity capable of being dealt with by the river, will have to be differently dealt with, with a corresponding reduction in cost compared with that which would be necessary if the entire sewage had to be so dealt with.

Capital, once expended, fixes the minimum yearly expenditure; outlay for chemicals can be increased or diminished according to circumstances; hence annual cost can be controlled.

Chemical and Physical Processes employed in the Treatment of Sewage.

BY

John C. Thresh, D.Sc., M.B., &c.

The few remarks I have to make in introducing this subject will refer exclusively to water-carried sewage.

The character and composition of such sewage need not be dwelt upon, and the causes of its variation in character, &c. in different towns

requires only to be alluded to briefly. In the majority of towns the sewers convey domestic sewage, manufacturing refuse, and rain and storm water. The domestic sewage may or may not include human excrement. The manufacturing refuse will vary in character with the staple industry. The rain and storm water chiefly affects the sewage by increasing its volume in proportion to the rainfall, and this occurs at irregular intervals. To avoid this disturbing element of variation in quantity, many towns recently sewered have adopted the "separate" system of sewerage, conveying as much of the rainfall as possible directly into the running streams. Where this has been done, the amount of sewage to be disposed of daily is a fairly constant quantity, and the difficulties in treating the sewage are reduced to a minimum.

The great variation in the strength and character of the sewage in different localities renders it impossible to devise any one system of treatment which shall be universally applicable. Moreover, the degree of purification required is not constant. Where the sewage can, with safety, be cast into the sea, or into the estuary of a tidal river, purification need not be nearly so complete as when its only outlet is into a stream which, a little lower down, furnishes the water-supply to the towns and villages on its banks.

The deleterious matters contained in water-borne sewage are chiefly "organic," and of two kinds, soluble and insoluble, the former being, of course, in solution, and the latter in suspension. The insoluble portion, again, may be divided into (*a*) living organisms: bacteria, &c.; and (*b*) dead organic matter.

The relative importance of these constituents of sewage in reference to its purification is a subject which admits of considerable diversity of opinion. It will, however, be admitted by all that where the effluent must pass into a stream furnishing the water-supply to communities lower down along its course, no system of treatment will be satisfactory which does not remove entirely any specific organisms which may be present, and all the suspended impurities. The dissolved organic matters also must be reduced to a minimum by precipitation, oxidation, or in some other way. To effect this a combination of processes is usually resorted to, physical and chemical. A classification of these is a somewhat difficult matter, inasmuch as certain groups overlap the others; but the following will, probably, answer every purpose:—

1. Subsidence—
   (*a.*) With complete rest.
   (*b.*) During slow, but continuous, flow.
2. Mechanical straining and filtration.
3. Chemical filtration; or percolation through materials exerting some chemical, or catalytic, action on the organic matters.
4. Precipitation by the addition of one or more chemicals. These may be—
   (*a.*) Soluble, as the salts of iron and alumina; or
   (*b.*) Insoluble, as clay, magnetic oxide of iron, and the various kinds of charcoal.
5. Electrolysis, or purification by electrical treatment.

6. Oxidation and destruction of the organic matter by addition of chemicals.
7. Sterilization and disinfection by the destruction of micro-organisms, and the arrest of putrefaction.
8. Nitrification, or the destruction of the organic matters by the action of the nitrifying organisms found in surface soils.
9. Irrigation, or the utilization of the organic matter as food for growing crops.

In exceptional cases only is any one of these processes alone found to yield sufficiently satisfactory results. To attain such results, two or more of them must be used in combination or in succession. Thus, after the addition of chemicals to effect precipitation, the precipitate must be removed either by subsidence or filtration, or by both, and the effluent may even require further purification, either by percolating through land for "nitrification," or through specially prepared chemical filters. Even where the sewage is passed onto the land, a preliminary straining or filtration, or a partial clarification by subsidence, is frequently resorted to; where it is not, the land itself will act as a mechanical as well as a chemical filter.

The various groups of processes may now be referred to *seriatim*.

1. *Subsidence.*—Practically, this is only applicable as a preliminary to some other mode of treatment, or after such treatment, or when the sewage is turned directly into the sea or a tidal river. When sewage is allowed to stand, the grit brought down from the roads after rain settles somewhat rapidly, carrying with it a little of the insoluble organic impurity. The remainder of the suspended matter falls so slowly that active putrefaction commences long before clarification is complete. After the addition of certain precipitating agents, the suspended particles fall more or less rapidly. Most rapid clarification takes place in sewage which has been rendered strongly alkaline by the addition of lime, and in which, by a judicious selection of chemicals and proper agitation, the precipitate is flocculent in character. When magnesia salts are added, a much smaller amount of lime is required to produce large flocculi. In other cases, insoluble substances, such as clay, ground coke, &c. are added, and, in subsiding, the particles carry down with them more or less of the previously suspended matter. The rapidity with which the insoluble matters subside is of importance chiefly as affecting the size of the tanks necessary for treating a given quantity of sewage. Subsidence takes place most rapidly, *cæteris paribus*, when the fluid is allowed complete rest. The slowest of motions along a tank retards the process. Very frequently such tanks are provided with screens, floats, dividing walls, &c., which, from their arrangement, retard still further, instead of accelerating, the deposition of the suspended matters.

2. *Mechanical Straining and Filtration.*—Straining, of course, is only intended to remove the coarser matters which are washed down the sewers. Filtration, on the other hand, attempts the removal of all suspended impurities. Sewage, unless previously treated by some chemical or other process, filters very slowly, and rapidly clogs up the pores in

the material used, whether this be sand, or charcoal, or earth. Most filtering materials, however insoluble in character, seem to be capable for a time of removing, not only the suspended matters, but a portion of the dissolved organic matter also. With the ordinary sand and gravel filter this action is slight and soon disappears, and mere filtration through such materials does nothing more than clarify the sewage. The number of micro-organisms may be enormously reduced, but masmuch as the soluble constituents of the sewage are unaffected, multiplication of the remaining organisms occurs with increased rapidity. No practicable system of sewage filtration can be relied upon to remove specific organisms or to sterilize the fluid. For the above reasons, filtration, *i.e.*, mechanical filtration, can only be considered of real service as an adjunct to some other process.

3. *Chemical Filtration.*—This term is employed, for lack of a better, to the filtration of sewage through materials of an insoluble nature, which, however, possess the power of withdrawing from solution, or otherwise of destroying, certain of the organic constituents. Animal charcoal is the type of such material, and the decolourization of a solution of caramel and the removal of alkaloidal bodies from solution when the fluids are passed through it are typical of the action of such a filter. The Rivers Pollution Commissioners found that filtration through either sand or a mixture of chalk and sand could purify a certain amount of sewage, and that the process was "essentially one of oxidation, the "organic matter being to a large extent converted into carbonic acid, "water, and nitric acid." Certain compounds of iron and manganese possess this power of causing oxidation in a very much higher degree than sand or chalk. Besides this action, however, substances like charcoal act by withdrawing certain organic matters from solution, by absorption or occlusion without at the same time necessarily causing their destruction. This action, however, is limited, and of little practical utility in sewage purification. Spongy iron, magnetic carbide of iron and polarite (which consists chiefly of magnetic oxide of iron) are the materials commonly employed in chemical filtration. When the filtration is intermittent, so as to allow of frequent aeration of the filtering medium, the action continues for a considerable period. Experiments which have recently been made with polarite filter beds seem to indicate that this substance retains its oxidizing powers for an indefinite period. When sewage has been previously treated either by subsidence or by some process of precipitation so as to remove most of the suspended matters, and as much as possible of the dissolved organic impurities, the clarified sewage passes rapidly through the polarite filter, and if the latter is properly constructed, a very considerable proportion of the remainder of the organic matter is oxidised, and the effluent attains a standard of purity "greatly exceeding that prescribed by the Rivers Pollution Commissioners." This process is now at work at Acton, near London, and at Swinton, near Manchester, and appears to give most satisfactory results.

It is highly probable that this combination of processes—precipitation, subsidence, and chemical filtration—will in the near future be regarded with the greatest favour.

4. *Precipitation Processes.*—These processes are so well known that it will be unnecessary for me to do more than indicate the principles upon which they are based. Precipitating agents are added for two purposes—to cause rapid precipitation of suspended impurities, and to remove as large a portion as possible of the impurities in solution. The number of materials and of combinations of materials which have been recommended or patented for purifying sewage by precipitation is very great. Few of them, however, have proved of practical utility. The salts of iron and of aluminium, with or without the addition of lime, are the chemicals now most frequently employed, and these yield the most satisfactory results. In very few instances, however, is an effluent produced of sufficiently high standard to permit of its being cast in large volume into a running stream. To effect this, further purification by chemical filtration, or sterilization, or oxidation must be resorted to. The London sewage, for example, after being precipitated is, during the hot weather, further dosed with an acid solution of potassium permanganate to oxidize the more putrescible constituents which have escaped precipitation. There is, however, another important series of precipitation processes which aims at the further purification of the sewage by the absorption or occlusion or destruction by oxidation or reduction of the organic matter which would otherwise remain in solution. The best known of these processes is probably that designated the ABC, from the initials of the three principal substances—alum, blood, and clay—used as precipitation agents. Here the blood, charcoal, and clay added are said to act as absorbents, and to carry down with them certain substances which would not be removed by the aluminium salts alone. Drs. Dewar and Tidy, who recently reported on this process, state "that it precipitates "60 per cent. of the organic matter in solution, and of the residue left "in the effluent at least two-thirds are non-albuminous, and, therefore, "of a nature less liable to putrefactive and other changes." The International Sewage Purification Company treat their sewage with "ferrozone" (a fancy name for a mixture of magnetic oxide of iron with salts of iron, alumina, and magnesia). A process of oxidation is said to accompany that of precipitation, but the effluent is further purified by being passed through a polarite filter bed.

Mr. Hanson uses as precipitants a mixture of lime and black ash-waste. The latter is said to contain a considerable amount of sulphites and hyposulphites, which, from their powerful reducing action, greatly improve the character of the effluent.

5. *Electrical Treatment.*—Quite recently Mr. Webster has patented a process for purifying sewage by electricity. The sewage is caused to travel along a trough in which are placed iron plates connected with the positive and negative terminals of a powerful dynamo. Water is decomposed together with, so it is stated, a certain portion of the sodium chloride present in all sewage. Iron enters into solution, and then precipitates a portion of the organic matter from solution, at the same time carrying down with it the suspended matters. A further portion of the organic matter is supposed to be oxidised by the nascent oxygen and chlorine oxides produced. The amount of sludge formed is said to be smaller than in any precipitation process, and

the effluent to be purer, rendering further treatment by filtration unnecessary "except to remove sentimental objections." The process has been experimentally tested at Crossness (with the London sewage) and at Salford, and the experts employed have given very favourable reports in both places. Extended series of experiments on a much larger scale are, however, necessary to convince the sceptical that this is other than a roundabout way of producing a soluble iron salt to act as the precipitating and purifying agent.

6. *Oxidation of Organic Matters by Chemical Agents.*—Attempts have frequently been made to destroy the organic matter in sewage by oxidising agents such as potassium permanganate, but the success hitherto has either been limited, or the expense prohibitive. Patents have also been taken out for oxidising sewage by forcing air through it. Something more, however, than mere contact with air seems to be necessary for the oxidation of the organic matter. From experiments made on a small scale in my laboratory, I found that a current of air passed through a sample of sewage for three hours, possibly the maximum of time during which sewage could be retained in the works for such treatment, produced practically no effect upon it. The suspended matter did not afterwards subside more rapidly, neither was the dissolved organic matter reduced in amount or apparently altered in quality.

7. *Sterilization and Disinfection.*—In this group of processes the removal of dead organic matter, whether in suspension or in solution, is only a secondary consideration, the object being to destroy, as far as possible, all micro-organisms, and so to prevent or retard putrefactive changes. Most of these processes are used but temporarily to prevent nuisances arising in the hot weather. Chloride of lime, carbolic acid, permanganate of potash, and many other substances have been recommended for this purpose. The practical utility of any such process, except as a temporary expedient, is more than doubtful. Unless sterilization is complete the surviving organisms will rapidly multiply, and even where the effluent is absolutely sterile it may contain a large amount of organic matter which, when poured into a river, will serve as pabulum for the organisms in the river water and cause their abundant increase. No doubt it would be a great point gained were we able to prevent specific bacteria from entering our streams with the sewage, but its importance is often greatly exaggerated. The water of streams exposed continually to the action of air and light does not seem to be a favourite habitation of such organisms, and it is probably much more important to avoid polluting the streams so as to render them tolerant of such visitors than to merely attempt to keep them out at those points where the processes can be adopted. A process which, whilst removing the maximum of organic matter from the sewage, would render it also sterile and otherwise innocuous would be the perfection of sewage treatment. Sterilization appears to be most completely effected by the "Amines" process, consisting essentially in the treatment of the sewage with a mixture of herring brine and milk of lime. The brine or some body formed by the action of the lime thereon

acts as the bactericide, and the lime as a precipitant. The effluent resulting from this treatment, though sterile, is alkaline, and contains much organic impurity in solution.

Some time ago a metropolitan committee recommended the addition of disinfectants to the sewage in the house drains and small sewers to prevent putrefaction and evolution of gases. From time to time patents have been taken out and suggestions made to enable each house to treat its own sewage before casting it into the sewer. Such arrangements may prove of service in isolated buildings with their own system of sewers, unconnected with any other system, but in other cases the advantages are problematical.

8. *Nitrification.*—In the process known as "intermittent downward filtration through land" the sewage is purified (*a*) by mechanical filtration, (*b*) by chemical action of the oxygen occluded in the soil, and (*c*) by the action of the living nitrifying organisms found in all fertile surface soil. On all hands it is now conceded that it is far preferable to filter the sewage mechanically or to remove suspended matter by precipitating agents before passing it through the soil. As a mechanical filter the pores of the soil more or less rapidly become choked, and the rate of filtration is in proportion reduced, aeration is rendered more difficult and less perfect, and the oxidizing action diminishes in energy. Properly prepared soils possess in a most marked degree the property of purifying sewage. The action is essentially one of oxidation effected in part by the oxygen occluded in the pores of the soil and in part by the action of certain organisms which occur in great abundance in such soils. The relative importance of these actions in the treatment of sewage is a matter concerning which much uncertainty exists, but the balance of evidence is probably in favour of the organisms discharging the most important functions. Müntz, in a recent communication to the French Academy, states that he regards "the work of the "nitrifying organisms as confined to the oxidation of nitrogenous "matter to nitrites," the further change of nitrites into nitrates being effected by the action of the oxygen and carbonic acid in the soil. Warrington, as a result of his recent researches, includes the following in his summary :—

1. The nitrification occurring in a mass of aerated soil is purely nitric in character. Soil readily converts a solution of nitrite into nitrate.
2. Pasture soil produces nitrites more readily than arable soil.
3. A clay subsoil, down to four feet from the surface was found to produce nitrates.
4. The nitrification effected by soil is thus explained. It is performed by two organisms, one of which oxidises ammonia to nitrites, while the other oxidises nitrites to nitrates.
5. In soil, the nitric organism is equally as active as the nitrous.
6. The nitrous organism requires no organic matter for its nutrition.
7. The presence of ammonia is a great hindrance to the action of the nitric organism.

From the above results it appears probable that these organisms act almost exclusively on the ammonia of the sewage, oxidizing it to nitric acid. With too concentrated a sewage the influence of the nitric organisms may be diminished, and nitrites appear in the effluent. The nitrous organism is, however, capable of producing nitrous acid in solutions of asparagine, milk, urine, and urea; the last mentioned being the most difficult to attack. Further researches in this direction are required to ascertain by what means the organic matter is decomposed in the soil into ammonia and carbonic acid. Probably, as the *micrococcus ureæ* splits up urea, so other similar organisms may be able to decompose the more highly complex nitrogenous constituents of sewage.

9. *Utilization of Sewage as Food for growing Crops, or Broad Irrigation.*—For the first time I have had to make use of the word utilization, for by broad irrigation only can raw sewage be put to any practical use. In many of the processes enumerated there is produced a sludge which innumerable attempts have been made to convert into a manure of sufficiently high fertilising power to command a sale in the market. None of these, however, have met with any great measure of success.

Whilst nitrification or intermittent downward filtration through land merely oxidises certain constituents of the sewage to nitrates, and the latter run to waste, in broad irrigation a certain portion of the nitrate so produced is assimilated by the crops grown on the farm. The proportion of the nitrogen so utilised varies considerably, not only on different farms, but on the same farm from time to time. Yet if only half the nitrogen can be saved, it is a larger proportion by far than can be abstracted and utilised by any other process.

Broad irrigation, as at present conducted however, does not seem to offer a final solution of the problem, how best to dispose of our sewage? In a few instances only has sewage-farming proved a success. With exceptionally favourable soil and situation such a farm may continue to be remunerative for many years, but it seems very probable that there is a limit to this period. Yet such a farm, even if it does not pay expenses, may still prove much more economical than a process of sewage treatment requiring costly plant and machinery, and a large annual expenditure in labour and in chemicals, and producing nothing but an unsaleable manure.

Apart, however, from the question of expense, many objections have been raised to sewage farms on sanitary grounds. And here again, as with everything else connected with this subject, opinions diametrically opposed are held and expressed. By one party it is said to give rise to offensive and injurious emanations, to pollute the subsoil water, and to favour the distribution of the ova of entozoa; whilst others assert that in a properly-conducted farm there are no such emanations, that the subsoil water is not polluted more than by the application of any other manure, and lastly, that there is no shadow of proof that disease attributable to entozoa has ever been due to the consumption of vegetable or fruit from a sewage farm.

I have now mentioned all the processes of practical value in sewage treatment, but there are many others, such as those necessitating distillation, freezing, &c., which are so obviously impracticable that it would be a waste of time even to enumerate them.

Do any of the processes mentioned, or any combination of such processes, enable us to get rid of our sewage in such a way as to give rise to no nuisance, cause no danger to health, and this at a cost sufficiently reasonable, considering the importance of attaining such results? This is the question I would submit to the Members of this Congress.

The Duty of a Locality to Utilise the Nitrogenous Matter in its Sewage for the Benefit of the Nation.

BY

ALFRED CARPENTER, M.D.

The object of this paper is to show that localities have duties to the nation to which they belong. It is not a sound argument to assert that the performance of these duties may have an apparently adverse result for the time being, by causing considerable expense. Some other course may possibly save the local authority an immediate capital expenditure, but if that course be persevered in, it may lead to much loss and mischief to the nation. The transportation of felons (the refuse of society) to the other side of the world, appeared for the time to save this country much trouble, but perseverance in that course would have involved disastrous results. In the case of sewage refuse, when the land is deprived of its natural requirement agricultural exhaustion ensues. It is one of the laws of nature that plant life is required for the support of animal existence; and the converse is also true, that growth of animal matter is necessary for the continued development of vegetable produce. The fruits of the earth, which are especially wanted for human subsistence, require for their rapid growth the continued or occasional application of ammonia, and various other salts, in addition to carbonic acid. As the density of population increases, the safety of the people requires that the land should have greater and more rapid powers of reproduction, and nature has not been regardless of this postulate. It is quite possible for a thickly peopled district to provide food for all its inhabitants without importing food stuffs. France, Holland, and Belgium, and more especially China, India, and Japan, are instances in point. It is true that famines have arisen, as the result of war or of extreme meteorological conditions, but the fact remains, that excluding these influences, the land has grown, and can grow, produce sufficient to support a densely peopled district. This has been brought about by the careful application of the excreta of the people to the soil itself, and a high

state of cultivation has procured large crops for the use of the inhabitants, while at the same time they have been preserved from the incidence of pestilence.

In consequence of the increase of wealth, and from other causes, such as the necessity for protection against the inroads of barbarians, or when a feudal baron had to protect himself against his next neighbour, people surrounded themselves with high walls, giving up in this country the habits of their Celtic and Saxon ancestors, who had wiser plans for the disposal of human excreta than their Norman successors. Human refuse then began to be stored in pits and cesspools, by which the subsoil in the towns and their immediate neighbourhood was polluted, and the progress of epidemics assisted whenever the meteorological conditions required for their manifestation arose.

The earliest hygienic indications which are found on record are in the Bible. Moses, the great Hebrew law-giver, ordered that human excreta should be conveyed to the earth, without the camp, and after the settlement in the land of Canaan, without the city, and all polluted articles, either of clothing or anything else, well washed with water. This law, established by a despotic authority, involved two points, 1st, the agricultural use of human excreta and its immediate conveyance to the soil; and 2ndly, the absolute necessity of an abundant supply of water.

As cultivation of the soil was the main source of wealth to the Hebrews, they soon became wealthy, and with riches came indolence and neglect of the laws laid down by Moses. They allowed their dwellings to be polluted, and prepared the way for their own overthrow by agents styled in Holy Writ "the armies of the living God." That is to say, the murrain among their cattle, the blasting, or blight, and mildew upon vegetation, with the palmer worm, the canker worm, and the caterpillar. These were clearly the disease germs which have only been scientifically demonstrated in recent years. It has been proved that their powers of multiplication are promoted by soil, air, and water polluted by human excrement, and when these pollutions are prohibited by authority, and their causes prevented, the locality which expends the necessary capital is ultimately repaid a thousandfold.

Coming to our own time, I venture to assert that a rate of a shilling in the pound, if judiciously dealt with, may be incurred with the certainty that its value will come back again. It is necessary that this expenditure should be general throughout the country, in order that complete results may be obtained. The law in this country has now decided that one locality shall not pollute another by casting its refuse outside its own boundary. It has come to pass that the cost of sanitary works, though great in the first application, has, in those districts where it has been judiciously applied, been productive of immense pecuniary benefit in the saving from sickness, incapacity from depreciated mental and muscular power, and early death. But while recognising the law as to cleanliness, the country generally has not awakened to the mischiefs which result from a neglect of the other portion of the ordinance. Human excreta is not as a rule conveyed to the soil, but impediments are placed in the way of its utilisation in this manner by many land-

i p. 1838.

owners and local authorities, with the result that agricultural produce is correspondingly diminished, and while population is increasing the people are rendered more and more dependent upon foreign countries for their food supplies. For more than 800 years human ordure has been mainly buried in the earth or passed away into the sea, or, worse still, into our running streams. By these means "the armies of the living God," the disease germs of modern times, have destroyed millions of people in the prime of life, and nature has been avenged for the neglect of sanitary law. Every human being discharges daily so many grains of phosphatic salts, and of material which becomes ammonia. Ammonia if not at once agriculturally utilised is reduced to its elements, carbonic acid nitrogen and water, thus losing 95 per cent. of its agricultural value, while the phosphates remain locked up in the cesspit, or pollute our water supplies. Phosphates are wanted for our wheat and other crops, and should be returned to the soil in the form in which they exist in human excreta. Had this been done, as ordered by our earliest authority on hygienic law, the constant re-application of the salts would have reacted, on the principle of small profits and quick returns, to the immense advantage of the people of the land.

There are several denunciations in Holy Writ, usually omitted in our public services, against those who pollute the walls of the city by micturition. No one can pass along the streets of any town or village in the kingdom, after 10 o'clock at night, and especially after the public-house closing hour, without witnessing the continuance of this act in our own time. I cannot exaggerate the evil, or say too much to draw the attention of local authorities to the mischiefs which result from the continuance in our cities, towns, and villages, of this indecent habit. Its denunciation in Scripture is not, in my opinion (as generally supposed), intended to indicate a judgment upon the people at large, but for the purpose of pointing out a breach of sanitary law in which the drunkard and the profligate indulged in Israel, as much as they do in Britain to-day. By this act the passer-by soon after may inhale a material capable of providing a forcing bed for disease germs, and allowing of the production of some of those forms of influenza and other catarrhal disorders which are so puzzling to the student in the etiology of epidemic disease, and are often the basis on which is established organic disease. These offences against decency are offences against the health of the community, and are taking from the nation a power to return to agriculture that which is required for the nation's welfare, for the larger part of the agricultural value of sewage is found in the urine. The denunciation of this act in Scripture is therefore called forth by a disobedience to hygienic law.

The habit helps to spread infectious disease. It also prepares the way for famine by removing from their proper place ingredients required for the nourishment of plant life in their most available form. It is often said that it will not pay a locality to utilize its sewage in the manner which I advocate, that to spend a sovereign in a way only likely to bring back ten shillings is economically wrong. This might be so if there were no other contingencies to be considered. But let me put before you the results of sanitation in my own town, Croydon. A death-rate of

26 per thousand and a rating equal to 6*s*. in the pound, more than 35 years ago, was followed by the capital expenditure of some 600,000*l*. in sanitary works for a population of 36,000 persons, gradually increasing in numbers as the expenditure went on. The death-rate has averaged, for the past 10 years, 14 per thousand, and the rating is at this moment 5*s*. 4*d*., though, in addition to a high Metropolitan Police rate, a School Board, public baths, public libraries, and nine public parks for the recreation of the people have been established in the district. The expenditure on sanitary works gives a beneficial return to the locality as well as to the nation, and has added much wealth to the district in which the works have been carried out.

The people of Croydon have expended some 230,000*l*. in the purchase of land for the purpose of sewage utilization during the past 30 years. They were prohibited by law from fouling the Wandle river, and injunctions obtained against the local authority before the year 1860 have never been dissolved, yet the effluent from the sewage farm has been discharged into the Wandle, and the authority has been unmolested by law ever since they applied the sewage to the land in the manner which is termed broad irrigation, while the cost to the ratepayers (exclusive of the purchase of the land) has never exceeded a twopenny rate. What have we had for this rate? Improved health, the employment of a large number of hands at improved agricultural wages, exceeding by five times the number formerly employed on the same land, a large increase in the amount of meat and milk at the service of the people, and, so far, the nation ensured against the chance of evil from scarcity. Surely these results are far in excess of the burden imposed. It is, in my opinion, a national mistake to allow the continuance of waste in the face of such national advantages.

Let me now turn to the condition of the Thames. It receives the sewage of the metropolis, which is treated chemically at an immense cost to the London County Council. The Croydon local authority used a lime process when the sewage was first applied to the land, it being then supposed to be a necessity of the work. Some large sums were annually expended in this operation, and nuisance was actually produced by the sanitary authority in the places where the tanks existed. These were removed some 15 years ago, and the sewage has ever since been discharged directly upon the land, without any other process than a rough straining through wire guards. The expense of treatment in tanks by the lime process has been saved, and it has been clearly demonstrated by our experience that such treatment is entirely unnecessary. If fresh sewage is discharged immediately upon the land before putrefaction has commenced, no evil will result to the locality to which it is conveyed. If sewage is kept moving at a fairly rapid rate no opportunity for putrefactive action will be given, and the sewage may be conveyed 40 or 50 miles in either closed or open courses with safety, provided that the closed mains are kept filled with moving sewage.

Let me apply the principle of this form of utilization to the sewage of London. Take the population at about 4,000,000. The average agricultural value of the refuse of each individual may be roughly

estimated as equal to that of a sheep for the same purpose. This has been put at 5*s*. per head by competent authority. Assuming this to be a minimum value, the sewage of London is worth, in the abstract, a million a year, independently of the national advantages which would result from its utilization. Let us assume, for a moment, that these advantages would justify the nation in guaranteeing the interest of 3 per cent. on 20,000,000*l*. devoted to such a purpose. If that amount were judiciously expended in promoting the Canvey Island or Maplin Sands' scheme, together with the erection of pumping stations at favourable points on the present collecting sewage outfalls, with covered rising mains conveying the sewage to high lands beyond the populous districts around the metropolis, immense areas of barren, uncultivated land might be converted into farms, producing luxuriant crops, and large agricultural populations would be provided with the means of subsistence, while increased supplies of milk, meat, and vegetables, would be at the command of the people, and, so far, there would be diminished scarcity of supplies in the event of complications with foreign nations. This would help to bring about the effects which are expected to result from the principle of allotments, now so strenuously urged upon Parliament by the advocates of healthy employment for the people. The estuary of the Thames would be freed from a condition which is a standing disgrace to a civilized community, and which, if persevered in for another half century, will inevitably damage the navigation of the river, and consequently the trade of the port of London.

Seven or eight years ago I acted as one of a committee for the erection of a third lunatic asylum for the county of Surrey. We arranged for the utilization of the sewage of 1,200 inmates by broad irrigation. The area irrigated is absolutely within a stone's throw and in front of its principal entrance. I append a letter received from the medical superintendent as to the result. I may add that the asylum has recently passed out of the care of the Surrey magistrates into the hands of the London County Council.

London County Asylum,
Cane Hill, Purley, R.S.O.,
April 4, 1891.

Dear Dr. Carpenter,

. . . . . .

No report on the result of our sewage utilization has been recently published. The sewage, as you are aware, is disposed of here on the land by gravitation. The process is simple in the extreme, one man managing the whole affair.

1. The health of the population of the asylum is unaffected in any way. Not the slightest discomfort or nuisance arises from the land irrigated, and this although it immediately adjoins the Brighton Road.

2. Italian rye grass is grown in large quantity, and is consumed as summer feed by the cows and horses. The portion irrigated is cut for two years, then ploughed and cropped for the two following with roots (mangold) and oats.

3. Financially, there is considerable profit, as the stock would require a much larger area of land if fed by grazing, or else a large outlay for some substitute for the rye grass.

Amount of land irrigated, nine acres. Asylum population, 1,250. No effluent.

Believe me,
Yours very truly,
JAMES MOODY.

About 20 years ago, the burgomaster of Dantzig, with a deputation from the governing body of that city, visited Croydon, and inspected our sewage farm. As a consequence of that inspection and of other information afforded to them, a sewage farm has been established at Dantzig, I now publish a letter from the manager of the farm.

Danzig Sewage Farm,
September 1, 1890.

DEAR SIR,

I HAVE been following, with great interest, the accounts in the "Times" of the meetings of the Sanitary Congress, and I cannot help writing you to confirm, from my experience, the views which you have expressed, viz., "the establishment of a number of sewage farms would "be better. It would be more desirable, instead of wasting the sewage, "to distribute it over an area where it could fructify. With people so "much in need of meat and milk as Londoners were, it was criminal to "destroy such a valuable means of production of those commodities." I have no doubt whatever the County Council will soon find itself compelled to do something besides polluting the seaside as well as the Thames, and no better beginning could be made than by carrying out the Maplin Sands or even the Canvey Island scheme. I am confident the result would be satisfactory, and that other sites would soon be offered or found. It is to me quite incomprehensible that the Council has taken no opportunity of viewing the Berlin sewage farms, which, despite the enormous outlay, are a most complete success. If the 1,720,000 inhabitants and ratepayers are *quite* agreed as to this, surely it is worth while looking at. Our farm here in Danzig has been visited this year by a great number of authorities from all parts of the world, exciting wonder as well as interest, for year by year the results are more satisfactory, financially as well as agriculturally. Only last week we entertained a large party of visitors from Austria, who were very much astonished to find whole plantations of Edelweiss, and to drink the capital red currant wine which is so much esteemed here, produced on the sand of the sea shore by the utilization of the Danzig sewage. Asparagus continues to be one of the best paying products, and commands a much higher price than that produced on the inland farms.

Yours respectfully and faithfully,
ALEX. AIRD.

Alf. Carpenter, Esq., M.D.

In addition, I may add the testimony given by Dr. C. E. Saunders, Medical Superintendent of the Sussex County Lunatic Asylum. When the congress of the Sanitary Institute was sitting at Brighton last year he invited the members to view the irrigated land at Hayward's Heath. He stated that the food grown upon the farm had all been consumed, directly or indirectly, within the asylum, and he pointed to the com-

paratively low death-rate at the asylum, and the absence of all zymotic maladies as a clear proof that the food used was free from all disadvantages.

I propose to deal with the objections that have been made on sanitary grounds to sewage farming in a second paper.

The Power of Soil and Vegetation combined to destroy Disease Germs, and so to prevent the Possibility of the Spread of Enthetic Disease in consequence of Sewage Farming.

BY

ALFRED CARPENTER, M.D.

At the meeting of the International Medical Congress in London in 1881, I had the privilege of introducing to the notice of the members the subject of sewage utilization by means of irrigation. I submitted nine propositions, and the evidence upon which those propositions were based, viz., the practical experience of 21 years' personal observation upon the Croydon sewage farms. A further experience of 10 years gained by closely watching the same farms (the areas being increased) has fully confirmed every word put before the great assembly of 1881. No essential part of that evidence has been successfully assailed, and every word might be repeated here if it could be done without loss of time. I will renew the propositions, so far as they bear on the power of soils to destroy the germs which in other positions are capable of spreading infectious disease.

Proposition 1.—That the judicious application of sewage in close proximity to dwelling-houses does not depreciate the health of the inhabitants. A continuation of the table then given of the vital statistics of the parish of Beddington and of the hamlet of Wallington will afford proof of this contention.

BEDDINGTON.

—	Population.	Rateable Value.	Births.	Deaths under 1 year.	Deaths over 60.	Total Deaths.	Birth rate.	Zymotic Disease.	Death rate.
		£							
1882 - -	2,485	17,689	64	6	3	18	25·7	None.	7·2
1883 - -	2,531	18,532	76	10	9	31	30·	None.	12·2
1884 - -	—	19,120	76	8	8	27	—	3	—
1885 - -	—	19,258	62	5	4	26	—	2	—
1886 - -	—	19,684	78	9	8	31	—	6	—
1887 - -	2,950	20,325	72	8	8	25	24·4	2	8·4
1888 - -	3,000	20,260	72	4	5	23	24·	1	7·6
1889 - -	3,050	20,156	58	3	3	12	19·	None.	3·9
1890 - -	3,250	20,216	61	6	6	16	18·7	2	4·9
1891 - -	—	20,203	—	—	—	—	—	—	—

WALLINGTON.

—	Population.	Rateable Value.	Births.	Deaths under 1 year.	Deaths over 60.	Total Deaths.	Birth rate.	Zymotic Disease.	Death rate.
		£							
1882 - -	3,007	21,912	89	12	10	43	29·5	None.	14·3
1883 - -	3,033	22,578	75	5	8	31	24·5	None.	0·1
1884 - -	—	23,217	92	10	8	33	—	2	4
1885 - -	—	23,888	85	9	19	48	—	2	—
1886 - -	—	25,870	110	8	14	33	—	1	—
1887 - -	4,900	26,172	101	9	7	35	20·5	4	7·1
1888 - -	5,500	26,126	72	10	19	41	13·	4	7·4
1889 - -	5,600	26,176	98	8	13	37	17·5	3	6·6
1890 - -	5,900	26,707	100	10	11	35	16·9	6	5·9
1891 - -	—	26,761	—	—	—	—	—	—	—

It will be observed from this table that the population has increased in a very rapid ratio, which is the more manifest when compared with that of 1861. The census of that year gave a population for the combined districts of 1,557, and a rateable value of 11,700*l.* Notwithstanding the existence of the sewage farm within the distance of less than a mile from the extreme limits of the district, there has been a rapid increase in both population and rateable value. The high birth rate has naturally raised the death rate, quite independently of outside influences, and the zymotic rate includes diseases such as whooping-cough, which cannot be laid to the charge of the farm.

Proposition 2.—That the judicious application of sewage to land will satisfactorily cleanse the effluent water, and fit it for discharge into any ordinary rivulet or water course. Recent analyses of the Beddington effluent, show that after 31 years continuous application of sewage to the same land, there is a persistent power in that land to deal with the applied sewage as satisfactorily as was the case when it was examined by the River Pollution Commissioners in 1867, as reported to Parliament. It may be that the effluent has not been at all times equal to these analyses. Errors of management, absence of manager, great rainfall, cleansing of carriers after haymaking or grass cutting, and the flushing which has to take place after such cleansing, tend for the moment to make the effluent chemically less satisfactory; but in no case has this been more than an accident, which can be, and has been, easily remedied. I need not labour at this proposition. Its truth has been abundantly demonstrated at other places besides Croydon, though not over so long a period of time, and chemical analyses of a highly satisfactory kind have been published in the sanitary journals.

Proposition 3.—That vegetables from fields continuously irrigated by sewage are satisfactory food for man and beast; that animals fed mainly on sewage produce are as healthy as animals fed on ordinary agricultural produce. I prove this by the emphatic statement that no evil effects have been shown to have followed from the consumption of the food which has been grown upon the 600 acres of land irrigated by

the Croydon sewage, or on the 1,200 acres irrigated by the Birmingham Corporation. The immense quantities of food in the way of meat and milk resulting from these large areas must have shown evidence of their unsoundness, if any had really existed. If, in addition to this, I take the evidence afforded by medical superintendents of lunatic asylums, such as that given in September by Dr. C. E. Saunders at Haywards Heath, and Dr. Moody at Cane Hill, it will not be necessary to write more to refute the imaginary notions of those who assume that sewage-grown produce must be unwholesome.

Proposition 4.—That excretions of those suffering from infectious and epidemic disease, when distributed upon land, as in broad irrigation, are immediately rendered innocuous. If rightly dealt with they cannot spread such diseases to those employed on the farm, or injure those who consume the produce, or set up similar disease in those living on the confines of the farm. No evidence has been adduced to contradict this proposition. I append extracts from the reports of the medical officer of health, who, acting for the rural sanitary authority, was not under the jurisdiction of the Croydon authority, and therefore gave an independent opinion.

Mr. Cressy reported (Lady Day, 1883): "I have to report for the "year 1882, an immunity from fever of every kind. The area reported "upon includes an asylum of 170 girls from 8 to 16 years of age, which "has a remarkable freedom from zymotic disease." This paragraph refers to the Beddington Female Orphan Asylum, a building containing nearly 200 occupants, and placed at the south-west corner of the farm, separated by a small brook from fields frequently under irrigation; and a north-east wind carries with it any miasma produced by more than half a mile of irrigated land.

In 1883 there was no outbreak reported except one, which the medical officer considered to have been caused by polluted water There were two cases of enteric fever resulting in one death.

In 1885, six cases of diphtheria were reported as arising in South Beddington, in houses at a high level on the chalk (a point the most distant in the parish from the farm) traced to local sanitary defects.

As to 1886, Mr. Cressy reports: "There has been no outbreak of "zymotic disease. A case of diphtheria did arise which was imported, "but there was no extension." Mr. Cressy, taking a survey in concluding his report says: "The district has been very free from infectious disease."

In 1887, two cases of typhoid, one being fatal, were reported, and referred to dirty hand-flushed w.c.'s. "The record, as far as infectious disease is concerned," says, Mr. Cressy, "speaks for itself."

In 1888, he says: "I find the health of my district even better than last year."

These reports corroborate the view put forth in 1881 to the fullest extent. It is true that a new medical officer of health has been recently appointed, who signalised his first report by a suggestion that as he had been unable to trace an outbreak of scarlatina in the Beddington Female Orphan Asylum, it might be produced by emanations from the Croydon sewage farm. This opinion is not supported by evidence worthy of

credence:—(1.) If it were true, scarlatina must have continuously affected the inmates of the school, and but few, if any, of the children sent there would have escaped the disease. The late Mr. Cressy's reports directly contradict this theory. (2.) There are living on the farm several families of children; most of them have not been affected by scarlatina. (3.) Considerable numbers of children at Hackbridge on the west, and at Waddon on the east, have never suffered from scarlatina; and the South Norwood district of Croydon, which is close to the South Norwood farm, has been singularly free from this disease as compared with other districts, and even with other parts of the borough of Croydon where scarlatina does not exist to anything like the extent found where there are no sewage farms. This clearly shows that the germs which promote the spread of scarlatina are not multiplied in areas devoted to broad irrigation, and it may be fairly assumed that the allied zymotic disorders are not capable of propagation from such areas, otherwise those diseases would be found to be more prevalent among the neighbouring residents than elsewhere. This is certainly not the case at Beddington or Norwood, or in the neighbourhood of any other sewage farm with which I am acquainted. Yet cases of scarlatina do occur in the borough of Croydon, in sufficient numbers for me to say that in no single month in any year have the excreta of scarlatina patients failed to reach the farm at Beddington.

Surely this evidence must be conclusive. I contend that the excreta of infectious patients are not capable of spreading infectious disease unless they have undergone a zymosis, which cannot take place if the excreta are cooled at once, aërated as they are on the surface of the soil, and brought into contact with the humus of the earth and the rootlets of the growing crops. An experience of 31 years has not produced any evidence to contradict this proposition. Sewage must be kept near to the surface of the soil so as to have the advantage of sunlight, air, and vegetable life. If sewage percolates deep into the soil out of reach of air and light, the ova of disease germs may be preserved ready for use upon some other opportunity, and possibly carried away in the effluent water. It is requisite, therefore, that ova be destroyed as well as the germs themselves. This destruction is best effected by vegetable life, and the means whereby this comes about are most numerous on the surface of the soil itself.

In close proximity to the north-western border of the farm is the populous village of Mitcham. Hear what Mr. Marshall, the medical officer of health, reported to the rural sanitary authority in the spring of this year. "Considering the amount of sickness at the beginning of the year as due to the prevalence of the influenza," and at the end of the year to the "severity of the weather, I think the mortality very moderate, "as was also the amount throughout the year of zymotic disease. "There has been in the district scarlet fever of a mild type, and only "one death is recorded."

Birth rate for year ending 31st March 1891 -	29·51
Death rate " " " -	11·93

The population of Mitcham is estimated at about 12,500.

Proposition 5.—When examining into this subject some years ago, I carried out a series of observations upon the power of rye grass to deal with the organisms found in sewage. A cubic yard of soil from Beddington was placed in a container and sown with rye grass. The seeds were treated every day with sewage dressings, and the application continued until effluent appeared at the provided outlet. The applied sewage was of the ordinary character; but occasionally urine, swarming with bacteria, was added. Microscopic examination of the effluent failed to discover any of these organisms in the liquid, even after it had been kept for three days. The best time to see the reason of this exemption is about the time at which the plant comes into flower. If the surface of the field is then closely examined, it will be seen to be covered by a felt like mass of minute radicles extending from the plant at the point at which it is attached to the soil. As the sewage is applied, the rootlets seem to be endowed with life, to become mobile; the bacteria adhere to them as they pass with the sewage through the living filter, and if these rootlets are examined through a magnifying glass, the germs are seen in an hour or two to disappear from view, as if digested by the plant itself. Hence I have presumed to apply to rye grass the term carnivorous.

It is by this natural process that the ova of disease germs are removed from the sewage, and the effluent satisfactorily cleansed. A similar result occurs when vegetable life is not active. The ulmic salts in the upper part of the soil have an attraction for living organisms similar to that existing in living vegetable root fibres. This humus is only to be found on the surface of the field, and this is the reason why sewage must not be allowed to filter deep into the soil. Intermittent downward filtration is not safe in its results, because the cleansing power of the humus may be overtaken, and disease germs escape with the effluent.

A microscopic examination of the soil from Beddington, showed myriads of living organisms within the first three inches of the surface. At a depth of one foot there were found not to be more than a tenth part of those nearer the surface. At two feet deep they were much less numerous; at the depth of a yard they were sometimes absent altogether, though the surface had been irrigated, more or less, during the whole of the year preceding that in which these experiments were carried out. The bacteria found in the soil evidently feed upon the organic matter contained in the sewage, and change it into elements fitted for plant use. It is thus that nature protects us from the natural consequences of animal existence. We have only to see that the laws of the universe are obeyed, and we then escape from the incidence of those diseases which disobedience entails. At the same time we grow increasing quantities of food for those who produce the sewage.

The proposition, therefore, is—Sewage when kept in motion and quickly brought into contact with soil and vegetable life is changed in a direction contrary to that which is necessary for the propagation of disease germs. It has been asserted that parasitic diseases are spread by sewage farms. I persistently searched for evidence of this before the year 1875, and have continued my observations since. I have not

met with cases of *tænia solium*, or tape-worm, in Croydon; there is no evidence of its existence in the case books of the medical officers reporting to the destitution authority (Board of Guardians). If cases had existed, some notice of them must have been found. I placed a mass of evidence on this point in the hands of the late Dr. Cobbold, and invited him to come down and examine for himself a large herd of oxen about to be slaughtered, which had been bred and grown on the Croydon farm. Dr. Cobbold at that time was in bad health and could not come; but, in a letter to me, he withdrew the charges he had made suggesting possible evils attendant on the establishment of sewage farms.

A microscopic examination of the flesh of those animals did not show a particle of evidence in support of the allegations.

To conclude, I have put before you a survey of every point bearing on the hygiene of sewage farming, and I claim to have proved that the utilization of sewage in the manner indicated is a national advantage.

DISCUSSION.

Sir Henry Roscoe hoped the discussion would take a purely scientific direction. He regretted the absence of Dr. Dupré on account of ill-health, as he had undertaken to bring before the Section the present mode of treatment of the London sewage. He, the President, had not been an advocate of the mode of treatment adopted by the late Metropolitan Board of Works and continued by the London County Council, and he therefore the more regretted that the subject could not be fully discussed. The President called attention to what he considered a most admirable report on sewage, which had just reached him, by the State Board of Health of Massachusetts. From the most elaborate series of experiments, both chemical and bacteriological, made upon the system of intermittent filtration, a most important fact was brought out which had hitherto been overlooked, namely, that in the process of the filtration of sewage through sand the action is not merely a straining out of the suspended particles, nor is it a merely chemical one; but by far the most important action is a purely biological one, inasmuch as each grain of sand appears to become the nucleus of a peculiar condition of the nitrifying organism, the activity of which brings about the nitrification and purification of the sewage applied to the filter. Air is absolutely necessary for this process of purification, and hence the importance of the filtration being intermittent. He believed the Section would be interested to hear the results of this important investigation, and that the Section would congratulate this American Congress on the remarkable work which they had carried out.

Mr. H. Alfred Röchling, C.E., said: Difficulties with the Leicester sewage, where he had been connected with the public works of the town, and where since 1855 almost every known chemical process had been tried and had signally failed, had forced the subject of sewage farming upon his notice; and the Berlin farms being the largest in existence, he had very carefully inquired into their working since their establishment. The Berlin Municipal Authorities, and especially Herr Marggraff, the Commissioner of the Farming Committee of the City Council, had generously placed a large amount of information concerning the farms in his hands by supplying him with plans and the yearly

reports, from which he had abstracted the following information: The total area of the irrigation farms has now reached 18,796 acres, but of this total only 7,942 acres are sewaged at present; the rest is being prepared as necessity occurs, the drainage of the city being extended every year. The land is bought when a suitable opportunity offers, and is farmed in the ordinary way until required for the disposal of sewage. The 7,942 acres sewaged at present are all in the four original sewage farms, which have an area of 11,016 acres; nearly all the sewage-treated land is under-drained. The following details refer solely to the four original farms: In Berlin all the liquid refuse from the houses goes into the sewers and is, together with some portion of the storm-water, lifted onto the farms by powerful machinery. The two southern farms are about 12 miles, and the two northern farms only about six miles, from the heart of the town. During the year 1889-90 (from 1st April 1889 to 31st March 1890, the official year) the sewage occupied about 10 to 12 hours in traversing the distance from the pumping station to the southern farms. The subsoil on the farms is chiefly sand, passing in places to sandy loam or loamy sand. There are three different modes of applying the sewage to the land, viz., in sloping grass plots (broad irrigation); in nearly level beds (filtration); and in perfectly level tanks (filtration). In broad irrigation the sewage enters the plot at the top, fills a small trench, and flows in a thin layer down hill. In filtration the land is divided into ridges about one yard wide, separated from each other by a trench, the ridges being generally planted with root crops, and the sewage is allowed to fill the trench only, in which it has to stand, getting sideways at the root of the crops but not coming into direct contact with the plant, and filtering away into the subsoil. In winter, when the ground is frozen to such a depth as to make irrigation impossible, the sewage is turned into large earthen tanks in which it stands till it has all disappeared in the subsoil. This mode of application is limited only to times of severe frost, and the area on which it is practised is only about one-twentieth of that specially prepared for sewage treatment; as might be expected, it does not purify the sewage to such an extent as either of the other modes. The expenses in connexion with the purchase and laying out were as follows (up to 31st March 1890):—

Purchase, 40*l.* 9*s.* 9*d.* per acre; distribution of sewage, 13*l.* 9*s.* 10*d.* per acre; laying out, 8*l.* 12*s.* 2*d.* per acre; draining land, 6*l.* 1*s.* per acre; sundry expenses, 4*l.* 9*s.* 6*d.* per acre: Total 73*l.* 2*s.* 3*d.* per acre.

The total quantity of sewage disposed of on the farms since their establishment has been 350,673,798 tons; and though they have dealt with this large amount, the land does its work to-day as well as ever it did before. The farms were practically not complete till 1885, and in the first year of complete farming (year ending 31st March 1886) a profit, in management only, of 1,509*l.* was realised, whilst in the year ending March 1889, a profit of 11,511*l.* was realised. If annual payments for capital expenditure are taken into consideration, all the profit of course disappears and is, indeed, changed into a loss; but even then it took only a rate of from 0·82 to 0·97 of a penny in the £ of the rateable value of property connected with the sewers to make up for the deficiency in the years 1885–90. The total expenditure for sewerage and sewage disposal works has now reached the sum of 4,080,440*l.* Professor D. Salkowski, of the Berlin University, has carried on a systematic investigation of the effluent waters from the farms, and has made altogether 296 analyses (up to 31st March 1890); from these it appears

that grass plots (broad irrigation) have abstracted 93·89 per cent. of organic pollution—as expressed in parts of permanganate of potash—and 98·15 per cent. of organic ammonia; beds (filtration) have abstracted 92·56 per cent. of organic pollution—as expressed in parts of permanganate of potash—and 97·72 per cent. of organic ammonia; tanks have only abstracted 82·60 per cent. of organic pollution. In connexion with the sewage farms the authorities have established a perfect system of recording not only all deaths but also all cases of sickness. Between 1885 and 1889 the average population per annum on the farms was 968 men, 825 women, and 327 children, or a total of 1,580 (61 per cent. men, 18 per cent. women, and 21 per cent. children); but of the total grown-up male population of 968, 850 are "correctionists" (street loafers, &c.) impoverished in health. The death-rates per 1,000 for all classes were 11·24 in 1885, 9·22 in 1886, 14·83 in 1887, 6·79 in 1888, and 4·81 in 1889. For the seven principal zymotics the death-rates per 1,000 were 4·32 in 1885, 3·69 in 1886, 4·15 in 1887, 1·13 in 1888, and nothing at all in 1889; or, if the cases are enumerated, there were in this period (1885 to 1889) seven deaths from scarlet fever, nine from diphtheria, one from typhoid, and three from diarrhœa, all, without exception, among children under 15 years of age. In 1889 there was a somewhat severe epidemic of typhoid fever in the city of Berlin, but not one case of typhoid fever was reported on the farm.

Dr. J. H. Gilbert said that, dismissing the subject of the methods of chemical treatment of sewage as a means of purification or of utilisation, as of comparatively temporary or limited utility, he would confine his attention to the application of sewage to the land. The two questions, of purification and of utilisation, must to a certain extent be viewed separately. If the position of a town were such that sufficient land for utilisation could not be obtained or reached without prohibitive expense, in most cases enough might be available for purification to the extent necessary to allow of the effluent passing into a river. Sometimes more or less utilisation may at the same time be combined. When, however, utilisation is a prominent object much more land is essential. But if, as should be the case, the application is mainly restricted to the growth of succulent crops, the area necessary would be much less than were the arrangements made with the object of including the growth of ripened crops, which require, and will bear, much less water. At the same time, assuming the scheme to be specially adapted for the growth of succulent crops, and mainly for the production of milk and meat, more or less land might sometimes be devoted within the area to the growth of grain or other ripened crops by limited irrigation, or by the use of the manure of the animals fed, if this be not made to contribute to the sewage. So far as we at present know, the purification necessary to allow of the effluent being discharged into a river is reached when practically the whole of the soluble organic nitrogen is oxidized into nitric acid; and in our climate it would only be for short periods of the winter that this result would not be sufficiently attained under proper management. A question arises, however, whether—although all the nitrogenous compounds were oxidized—all injurious organisms would be removed, and this is a point requiring further investigation. But obviously it would be an advantage if the organisms effecting the several stages of the nitrification process were not removed, but passed into the river. There can be no doubt that, although purification is of first importance, utilisation for succulent crops, which would take up the manurial matters more

[illegible]

Colonel Jones [illegible]

Mr. G. H. Brenner [illegible]

Dr. C. R. Drysdale [illegible]

Mr. T. J. Perry [illegible]

Mr. W. C. Sillar [illegible] regarding it as a [illegible] practical system [illegible] irrigation and pointed out the [illegible] demand for the manure thus obtained. He denied the statement [illegible] ammonia and phosphates were added to the manure to increase its [illegible]

Mr. C. E. Saunders insisted on the absence of nuisance or other [illegible] the proximity of a sewage farm when the sewage is [illegible] by broad irrigation. He objected to the introduction

of a commercial element into the discussion, as the scientific aspect of the case should not be mingled with the commercial.

Dr. Alfred Carpenter stated that the crude matters are first removed from the Croydon sewage, and the latter then passed directly on to the land. With regard to the statement that people would not care to live near a sewage farm, he pointed out that there were many villas around the Beddington farm.

Dr. E. Haughton was prepared to provisionally support the use of sewage by spreading it over sewage farms, but did not consider all localities suitable for the purpose, and hoped the day would come when the dry method would be perfected, and the so-called sewage system would be superseded by the no-sewage system.

Alderman Boulton (Corporation of Burslem) stated that the irrigation system had been adopted at Burslem with great success, but deprecated the fact that the land obtainable for this purpose was always sold at much higher than the market price.

Mr. Cripps (Tottenham) pointed out that the system mentioned in Dr. Thresh's paper as being in use at Tottenham had now been given up, and that Tottenham had paid a fine of 30,000*l.* to join the Metropolitan sewage system.

Thursday, 13th August, 1891.

The President, Sir H. Roscoe, in the Chair.

Kritische und experimentelle Studien über die hygienische Bedeutung des Kupfers.

VON

Professor Dr. K. B. Lehmann, Vorstand des hygienischen Instituts, Würzburg.

Seit der Mitte des vorigen Jahrhunderts beschäftigt die Kupferfrage die wissenschaftliche Welt. Bis zu den fünfziger Jahren dieses Jahrhunderts war das Dogma von der hohen Gefährlichkeit des Kupfers trotz vereinzelter Widersprüche unbefangener Beobachter (z. B. Ellert) allgemein acceptirt, dann folgte eine gewaltige Reaction, die in dem Satze gipfelte: "*Kupfer ist kein Gift.*" Namentlich Erfahrungen practischer Aerzte über die Ungefährlichkeit der Anwendung selbst hoher Kupferdosen bei der Behandlung von Croup waren unvereinbar mit der Lehre von der hohen Giftigkeit.

Die sorgfältigen Arbeiten der letzten Jahrzehnte, unter denen namentlich die von Toussaint, Galippe und Du Moulin genannt sein

mögen, haben weitere Klärung gebracht. A. Gautier's verdienstvolle Schrift "Le Cuivre et le Plomb" hat in weiteren Kreisen maassvolle Anschauungen über die wahre toxicologische Bedeutung des Kupfers zu verbreiten gesucht.

Derselbe Autor hatte auch mit Bouchardat auf dem hygienischen internationalen Congress in Paris 1878 die Reverdissagefrage zu behandeln, die er im Sinne eines Compromisses zu lösen vorschlug: Es sollten bis 18 mg. Kupfer (die gerade für Erbsen hinreichende Menge) pro Kilo Gemüse zugelassen werden. Da Bohnen mehr Kupfer zu ihrer Grünfärbung bedürfen, als Erbsen, so sind jetzt, meines Wissens, 40 mg. Kupfer pro Kilo Gemüse in Frankreich zugelassen.

Aber trotz dieser Aufklärungen findet man noch in den weitesten Kreisen Unklarheit in der Kupferfrage. Wie weit die Ansichten unter hervorragenden Aerzten und Toxicologen noch auseinander gehen, bewies aufs Klarste die fast endlose Debatte der belgischen Academie 1884, die über die Frage des Ministers entbrannte, ob ein Kupferzusatz zu Nahrungsmitteln als gesundheitsschädlich zu betrachten sei.

Du Moulin vertrat, von einigen Collegen unterstützt, die These: "Kupfer ist kein Gift" bis in alle Consequenzen, wurde aber von der Mehrheit überstimmt. Doch gingen die Ansichten seiner Gegner weit auseinander, es fanden sich alle denkbaren Abstufungen der Beurteilung des Kupfers von der ächten Cuprophobie bis zur kritischen Würdigung der wirklich nachgewiesenen Schädlichkeiten neben einander vertreten. Der Beschluss lautete: "Es sei dem Minister zu empfehlen, jede " Anwendung von Kupfersalzen zu Speisezwecken zu verbieten, da sie " schädlich seien."*

Die Darstellung aller Autoren leidet unter dem in der Litteratur stets hervortretenden Widerspruche:

So viele therapeutische und experimentelle Erfahrungen scheinen eine relative Unschädlichkeit des Kupfers bewiesen zu haben, daneben enthält bis in die allerneueste Zeit die Litteratur fortwährend vereinzelte Berichte über schwerste akute Vergiftungen durch relativ geringfügige Kupferdosen. Die Unsicherheit der Verfasser der Lehrbücher tritt auch in den gerichtsärztlichen Gutachten immer wieder zu Tage. Auch die Frage der chronischen Kupfervergiftung wird von den meisten Autoren ohne rechte Ueberzeugung verhandelt.

Bei diesem Stande der Frage schien es mir erspriesslich, mit einigen Schülern noch einmal ein vorurteilfreies, gründliches experimentelles und litterarisches Studium der Kupferfrage vorzunehmen und ich hoffe bei der Section Interesse für eine kurze Darlegung der wichtigsten Resultate zu finden. Auf die Wiedergabe von Einzelheiten und eingehender Litteraturkritik und Litteraturcitirung muss ich natürlich hier bei der Knappheit der zugemessenen Zeit verzichten.

---

* Eine Substanz nenne ich im Folgenden *gesundheitsschädlich*, wenn sie in den Dosen, in denen sie in den Körper gelangen kann, eine unverkennbare, wenn auch leichte und vorübergehende Störung der Gesundheit bedingt, *giftig*, wenn sie schwere Störungen oder den Tod verursacht. Man hat vielfach den Forschern, welche die Giftigkeit der Kupfersalze leugneten, die Ansicht zugeschrieben, auch ihre Schädlichkeit zu leugnen; so weit ist aber kaum einer gegangen.

I.

Da hier nur von der ökonomischen Bedeutung des Kupfers gesprochen werden soll, so ist vor Allem anzugeben, welche Kupfermengen durch den Haushalt überhaupt in den Körper gelangen können.

Wir brauchen bei dieser Ueberlegung den natürlichen nicht unbedeutenden Kupfergehalt zahlreicher Vegetabilien nicht mit in Rechnung zu ziehen, da derselbe hygienisch offenbar ganz bedeutungslos ist. Es interessirt uns nur der Ueberschuss über diese normale Menge, wie er auf zwei Wegen in die Nahrung kommen kann.

1. Durch absichtlichen Zusatz von Kupfersalzen:

a. zu Gemüsen zwecks Grünfärbung (Reverdissage);

b. zu Mehl, um seine Backfähigkeit zu erhöhen, das Aussehen des daraus gebackenen Brotes zu verbessern und seinen Wassergehalt zu vermehren.

2. Durch Nachlässigkeit:

a. unpassende Verwendung *reiner* Kupfer- oder Messinggefässe bei der Speisebereitung, d. h. Stehenlassen saurer oder fetter Speisen in Metallgefässen nach dem Kochen;

b. Verwendung ungereinigt stehen gelassener, grünspahnbeschmutzter Kupfergeräthe.

Es handelt sich um exacte Angaben, welche Mengen von Kupfer auf diesem Wege in den Körper gelangen können:

1. Durch absichtlichen Zusatz:

a. In Gemüseconserven sind gefunden in 1 Kilo:

(1) von Riche und Magnier de la Source:

in Erbsen - - -	16	Milligramm Kupfer
in Gurken - - -	18	„ „
in Bohnen - - -	35–45	„ „

(2) von Gautier:

im Durchschnitt etwa	60
im Maximum	125
im Minimum	16

In Deutschland fand soeben Mayrhofer etwa 25–35 mg. Kupfer im Durchschnitt in vegetabilischen Conserven.

Die höchsten Werte, die bisher gefunden wurden, sind:

184	Pariser Laboratorium, Erbsen.
180 u. 270	Chatin u. Personne, Erbsen.
200	Cronquist, Stockholm.

Wo Angaben vorhanden sind, heisst es meist, dass der Geschmacksinn diese Kupfermengen nicht entdeckte.

Um zu bestimmen, welche Kupfermengen sich in Gemüse hineinbringen lassen, ohne dass sich der Kupfergehalt dem Geschmacksinn verräth, habe ich absichtlich Gemüse mit Kupfer behandelt und ihren Gehalt analytisch festgestellt.

Erbsen mit 186 mg. im Kilo schmeckten noch gar nicht nach Kupfer.

„ 244 „ haben keinen Kupfergeschmack.

Erbsen mit 634 mg. im Kilo werden noch ohne Widerwillen gegessen, haben aber widerwärtigen anhaltenden Nachgeschmack.

Bohnen mit 740 mg. im Kilo schmecken abscheulich und sind ungeniessbar.

Es bestätigen und erweitern also diese Angaben die Versicherung Gallard's, dass er und andere Personen an Erbsen mit 180–270 mg. Kupfer im Liter nichts geschmeckt habe.

b. Im *Brot* sind schon gefunden bis 130 mg. pro Kilo, doch ist solches Brot, obwohl noch frei von Kupfergeschmack, schon durch seine grünliche Farbe auffällig.

Es sind übrigens etwa 12–15 mg. (= 50 mg. Kupfersulfat) nach Bruylants ein vollkommen hinreichender Zusatz von unverkennbarer und vorzüglicher Wirkung, wenn man genöthigt ist, schlechtes Mehl zu verbacken.

2. Durch Kochen oder Aufbewahren in Kupfergefässen:

a. Bouillon:

(1) Reissuppe, 24 Stunden in Messing stehend enthält nach Mair in 1 Liter 24 Milligramm Kupfer und schmeckt sehr schlecht, kaum geniessbar.

(2) Eigene Versuche:

α. In einer Messingpfanne wird 1 Pfund Fleisch mit 1 Liter Wasser und entsprechend Salz 1¾ Stunden gekocht, das Fleisch herausgenommen, die Brühe auf einen Liter aufgefüllt und nun in der Pfanne stehen gelassen. Nach 24 Stunden Geschmack unverändert, in 1000 cbcm. 18 Milligramm Kupfer. Nach 48 Stunden grünliche Farbe, Geschmack fast unmerklich verändert, in 1000 cbcm. 36·8 Milligramm Kupfer.

β. In einer 7 Tage absichtlich mit etwas Bouillonresten stehen gebliebenen sehr schmutzigen, grünspahnbedeckten Messingpfanne wird der Versuch wiederholt.

Nach 24 Stunden blassgrün, 40 Milligr. Kupfer, } Geschmack schwach, etwas Nachgeschmack.
Nach 48 Stunden deutlicher grün, 58 mg. Kupfer, }

Der Geschmack wird also etwa von 40 Milligramm im Liter Bouillon an unangenehm, wenn kein Grünzeug* zugesetzt wird.

b. Fett:

Es wurde in blanke Messing- und Kupferschalen von 100 und 75 cbcm. Inhalt 75 resp. 50 cbcm. ausgeschmolzenes, filtrirtes, kochsalzfreies Butterfett eingegossen. In den verschiedenen Versuchen wurde bald stark, bald schwach ranziges Fett verwendet, dasselbe bald 1 Stunde auf 120–180° in der Schale

* Bei reichlichem Grünzeug- (Julienne-) Zusatz konnten wir noch Suppen herstellen, die mit 75 und 100 Milligramm im Liter erträglich schmeckten, mit 200 Milligramm aber schmeckte Suppe unerträglich, trotz Grünzeugzusatz. Wurde das Kupfer als Acetat zur Brühe gesetzt, solange das Fleisch noch mitkochte, so waren 200 Milligramm Kupfer mit Leichtigkeit in der Masse (Suppe + Fleisch + Gemüse) ohne auffallenden Geschmack unterzubringen.

erhitzt, bald nur heiss eingegossen und (24 bis 7 mal 24 Stunden) stehen gelassen. Von den 15 hieher gehörigen Versuchen sei nur erwähnt, dass 100 cbcm. stark ranziges Fett (Rancidität 9) in 14 Tagen 8·7 mg. Kupfer aufnahmen. Es war hier das Fett nur heiss eingegossen.

Aehnliche Mengen wurden durch einstündiges Erhitzen auf 160° und 24stündiges Stehenlassen erhalten.

Schliesslich wurde eine blanke Messingschale von 90 cbcm. Inhalt ½ mm. hoch mit Butter von der Rancidität 10 eingerieben und 24 Stunden im Zimmer stehen gelassen, das Fett färbte sich intensiv bläulich grün. Hierauf werden 50 cbcm. Butter von Rancidität 8 eingegossen und wieder 24 Stunden stehen gelassen. Untersuchung wie oben ergibt 5 mg. Kupfer, also in 100 cbcm., 10 Milligramm Kupfer.

c. Wein (kalt):

In Gläsern, die je 2 Liter sauren fränkischen Landwein enthielten, tauchten 600 Quadratcentimeter Kupfer- resp. Messingblech bald ganz unter, bald ragte ein Stück Blech über die Oberfläche empor. Es zeigte sich, dass bei herausragendem Blech mehr Kupfer in Lösung ging und dass aus Messingblech etwas mehr als aus Kupferblech aufgelöst wurde.

1 Liter Wein nahm beispielsweise aus hervorragendem Kupfer auf:

In 24 h. - - -	21 mg. Cu.
In 7 mal 24 h. - - -	56 „ „

Ueber den Geschmack kann ich noch folgende Angaben machen:

Wenn 1 Liter Wein (als Acetat) enthält:

Gehalt.	Eigenschaften.
50 mg. Kupfer - -	gut geniessbar.
100 „ „ - -	zeigt schwachen Nachgeschmack.
150 „ „ - -	kaum geniessbar, starker Nachgeschmack.
200 „ „ - -	ungeniessbar, leicht blaugrünliche Farbe.

d. Essig (kalt):

Versuchsverfahren wie bei Wein.

Ein Liter nahm auf:—

—	Herausragendes Messing.	Herausragendes Kupfer.
In 24 h. - - - - - -	61 mg.	55 mg.
In 7 mal 24 h. - - - - - -	195 „	155 „

Besondere noch nicht abgeschlossene Versuche zeigen, dass auch saure Ragouts, Sauerkraut u. dergl. nur bescheidene, oft sogar nur sehr geringe Mengen aus Kupfergefässen aufnehmen.

II.

Fragen wir nun, gestützt auf die ermittelten Zahlen, welche Kupfermengen können im ungünstigsten Falle durch eine Mahlzeit in den Körper gelangen, ohne dass es den Sinnen zu sehr auffällt? Die grüne oder blaugrüne Farbe, vor allem aber der adstringirende Kupfergeschmack, werden ja vor allzugrossen Mengen warnen. Nehmen wir an, dass die Mahlzeit bei Licht oder schlechter Beleuchtung verzehrt werde, so dass die blaue Farbe der Speisen weniger bemerkt wird, so können wir nur durch den Geschmacksinn aufmerksam werden.

Im schlimmsten Fall könnte so etwa bei einem wenig empfindlichen Gaumen in einer starken Mahlzeit in den Körper gelangen:

In 300 ccm. Suppe - - -	- 20 mg.
„ 1 Liter Wein, der in Kupfer stand	- 50 „
„ 50 ccm. Essig, „ „ -	- 10 „
„ 50 g. Fett, das zum Braten diente	- 5 „
„ 200 g. stärkst gekupferten Erbsen	- 50 „
„ 500 g. maximal kupferhaltigen Brotes	- 60 „

Also im Maximum 195 mg. Doch wird natürlich ein solcher Fall nie vorkommen.

Das leuchtet aber sofort ein, dass viel leichter in einer aus kupferhaltigem Brot und Conserven bestehenden Mahlzeit hohe Kupferdosen in den Körper gelangen, als durch Suppe, Ragout u. drgl., selbst wenn sie in grünspahnbedeckten Kupfergeschirren hergestellt werden, wenn nur keine stark sauren Gemüse in Kupfer gekocht und erkaltel sind.

Wenn wir die Conserven und das Brot ausschliessen, wird überhaupt selten mehr als 30–50 mg., kaum jemals 100 mg. Kupfer bei einer Mahlzeit in den Körper gelangen können, in Conserven und Brot dagegen ziemlich leicht 100, ja bis 200 mg.

III.

Auf die Frage, von welcher Menge ab reine Kupferpräparate bei einmaligem Einnehmen wirken, antwortet die Pharmacologie, dass Dosen von 10–30 mg. Kupfer in hinreichender Verdünnung meist wirkungslos sind, dass etwa 50–100 mg. Kupfer Ueblichkeit, Brechreiz und in der Regel Brechen erzeugen.

Auch von grösseren Dosen bis etwa 200 mg. (d. h. etwa 0·8 g. Kupfersulfat), auf einmal genommen, findet sich nirgends eine andere beglaubigte Wirkung als Erbrechen angeführt, höchstens sind noch kolikartige Leibschmerzen und schmerzhafte Diarrhoen erwähnt.*

Zu therapeutischen Zwecken fanden oft sehr grosse Dosen Verwendung. Kinder nahmen z. B. bei Du Moulin in 5–6 Tagen $1\frac{1}{2}$–$2\frac{1}{2}$ g.

* Mischt man Hunden oder Katzen, die vorher nie Kupfer erhielten, unter die Nahrung auf einmal eine concentrirte Lösung von 1 g. Kupfersulfat = 250 mg. Kupfer, was nicht immer leicht eingenommen wird, so brechen auch diese Thiere blos und zeigen keine weiteren Symptome. Tötet man sie, so sind höchstens ganz minimale Anätzungen an der Magenschleimhaut (Röthungen und Epithelabstossungen) zu sehen. Und doch entspräche diese Dosis (50–100 mg. Kupfer pro Kilo) beim Menschen einer ganz gewaltigen Gabe.

Kupfersulfat, d. h. pro die c. 0·5 g. Kupfersulfat = 120 mg. Kupfer. Sie erbrachen oft nur die ersten Dosen und behielten das übrige bei sich. Ja in einzelnen Fällen verordneten Aerzte bis zu 1 g. Kupfersulfat = 250 mg. Kupfer an einem Tage. Niemals wurde irgend ein Schaden davon gesehen, selbst wenn nur wenig gebrochen wurde.

Die kleinste genau bekannte Dose eines reinen Kupfersalzes, von der ich eine ernstere Affection eines Erwachsenen in der Litteratur sichergestellt beschrieben finde, ist etwa 5 g. Kupfersulfat = 1,200 mg. Kupfer; einmal soll ein Kind an 1·2 g. Kupferchlorid, d. h. 560 mg. Kupfer gestorben sein, was bei der ätzenden Wirkung des diesmal ziemlich concentrirt genommenen Präparates wohl glaublich erscheint. Aber grade zur Einführung concentrirter Lösungen ist *im Haushalt* am wenigsten Gelegenheit gegeben. Dass es, wie es eine Idiosynkrasie gegen Erdbeeren, Krebse, Morphium, Ammoniakgas, schweflige Säure und viele andere Stoffe giebt, auch eine solche für Kupfer gelegentlich einmal geben kann, soll nicht geleugnet werden; solche Abnormitäten werden aber ohne jeden Einfluss auf unsere Reflexionen bleiben müssen. Crog hat Personen beobachtet, die angeblich 30 mg. Kupfersulfat = 8 mg. Kupfer auf einen ganzen Tag vertheilt nicht vertragen, ja, nach einer Angabe Blodig's hat Letzterer Intoxicationssymptome durch blosses Aetzen der Conjunctiva mit Kupfersulfatcrystallen beobachtet.

IV.

Die Vermuthung, dass einzelne Kupfersalze vielleicht schädlicher wirken als die anderen, entbehrt jedes Beweises. Es sind bisher von den einzelnen Autoren und mir selbst Acetat, Sulfat, Carbonat, Citrat, Succinat, Chlorid, von mir speciell vielfach Butyrat, Oleat, Lactat geprüft worden, ohne dass eine wesentliche Differenz der Wirkung bestände. Aber auch die verschiedenen Versuche der Autoren mit Kupferalbuminaten können nur die Ueberzeugung verstärken, dass eine specifische Wirkung irgend welcher Kupfersalze, wenn sie nicht an giftige Säuren gebunden sind, nicht besteht.

In einem Versuch, in dem ich selbst 132 Milligramm Kupfer in 200 Gramm selbst grüngefärbter Erbsen verzehrte, wurde bei dem Essen wenig unangenehmer Geschmack, aber etwa ½ Stunde anhaltender kupferiger Nachgeschmack bemerkt; nach dreistündiger abwechselnd schwerer und leichterer Nausea trat ein zweimaliges heftiges Erbrechen, dann aber vollkommenes Wohlbefinden ein, vier Stunden später wurde mit Appetit zu Abend gegessen.

V.

Die Litteratur enthält keinen einzigen Fall von akuten Vergiftungen durch kupferhaltiges Brot oder Conserven, obwohl, wie wir sahen, auf diesem Wege am Leichtesten grosse Kupfermengen eingeführt werden und sicherlich schon häufig eingeführt worden sind, namentlich solange die Controlle nicht streng und die Verwendung des Kupfers zu diesen Zwecken in manchen Ländern allgemein war.

Dagegen sind eine Menge Fälle gut oder schlecht beschrieben, in denen schwerste, ja tödtliche Erkrankungen eintraten, nachdem eine

Suppe, ein Ragout oder drgl. verzehrt war, das nachher als kupferhaltig erkannt wurde. Wenn überhaupt die Untersuchung auf Kupfer quantitativ ausgeführt wurde, so ergab sie in diesen Fällen niemals Zahlen, die es auch nur entfernt darthun, dass einer der Erkrankten auch nur 150–200 Milligramm verzehrt habe; gewöhnlich liess sich nur die Aufnahme von 20–50 Milligramm Kupfer wahrscheinlich machen.

Da sich weder viel Kupfer noch die Anwesenheit besonders giftiger Kupferverbindungen in den mit Kupfergeschirren bereiteten Speisen nachweisen lässt, so drängt sich dem Unbefangenen die Annahme auf, dass vielleicht neben den Kupferverbindungen andere Gifte vorhanden gewesen sein möchten.

Die Thatsache, dass in vielen der sogenannten Kupfervergiftungen nach Einführung kleiner Kupfermengen neben Brechdurchfällen die verschiedensten nervösen Störungen wie Kopfweh, Zittern, Manie, Scorbut, bei den Sectionen schwere geschwürige Magendarmentzündungen angegeben werden, spricht auch sehr gegen die Bedeutung des Kupfers.

VI.

Die ökonomischen "Kupfervergiftungen" sind meist durch Nahrungsmittel bedingt, die *längere Zeit* in Kupfer aufbewahrt waren; nehmen wir nun an, dass dabei gebildete Bacterienstoffwechselproducte die eigentliche Schädlichkeit darstellen, so erscheint die grosse Mehrzahl der "Kupfervergiftungen" in ganz anderem Licht. Jetzt ist ohne weiteres verständlich:

1. warum so wenig Kupfer zur schweren Vergiftung nöthig erscheint;
2. warum die stets sehr kupferarme Fleischbrühe, Ragouts u. dgl. so oft Kupfervergiftungen bedingen, dagegen stark kupferhaltige Conserven noch nie ernstere Erkrankung erzeugen;
3. warum die Krankheitsbilder so verschieden sind, oft von schweren nervösen Symptomen begleitet;
4. warum so häufig bei dunkeln Vergiftungsfällen ganz die Symptome der sogenannten "Kupfervergiftung" auftreten, ohne dass eine Spur Kupfer nachgewiesen werden konnte, so sehr man auch nach dieser bequemen Erklärung für die Störung gesucht hatte;
5. warum mit der zunehmenden Kenntniss von den Ptomaïnvergiftungen die Kupfervergiftungen in der Litteratur immer seltener werden.

Es soll damit nicht gesagt sein, dass nicht auch andere organische oder anorganische Gifte gelegentlich einer Kupfervergiftung vorgetäuscht haben.

Es möge mir gestattet sein, an einigen älteren und neueren Fällen meine Ansicht über die angeblich bewiesene Bedeutung der Kupfergeschirre zu zeigen.

Johann Peter Frank erzählt in seinem vorzüglichen "System einer vollständigen medizinischen Polizei, 1783," neben einigen anderen

Alarmgeschichten über die Giftigkeit des Kupfers im Eifer einen Fall, in dem die Väter des Oratoriums zu Angers alle nach dem Genuss eines Ragouts sehr schwer erkrankten, welches in einem völlig reinen *gut überzinnten kupfernen* Gefäss nur aufgewärmt worden war. Wer zweifelt hier an einer Fleischvergiftung?

Navier (1772) berichtet von schweren Vergiftungen an 7 Personen einer Familie durch einen Kuchen und Ragout und Suppe. Es soll hier ein kupferner Schaumlöffel, mit dem das zum Kuchen verwendete Butterschmalz abgeschäumt wurde und der auch zum Abschäumen der Suppe Anwendung fand, an dem Unglück schuld gewesen sein. Diese Erklärung ist einfach grundlos, die Möglichkeit einer nennenswerten Kupfereinführung ausgeschlossen,—eine Ptomaïnvergiftung durch das Fleisch, eine Barytvergiftung oder Mehlptomaïnvergiftung durch den Kuchen unendlich wahrscheinlicher.

Die berühmte oft citirte von Pleischl und Heller 1847 im Krankenhaus zu Wien beobachtete "Kupfermassenvergiftung" kann ich auch nicht auf Kupfer beziehen. Es erkrankten 130 Personen, von denen neun theils unter den Symptomen der Manie, theils des Scorbuts zu Grunde gingen! Die Ulcerationsprocesse im Darmkanal wären nur bei sehr grossen ätzenden Kupfermengen auf letzteres zu beziehen; so bildet die ganze Erkrankung das schönste Pendant zu den Fleischvergiftungen der neueren Zeit, wenn auch Heller etwas Kupfer in den Speiseresten und im Erbrochenen der Kranken fand.

Für die beiden neuesten von Mair beschriebenen tödtlichen Kupfervergiftungen (Friedreichs Blätter 1887) kann ich auch durchaus nicht den Beweis, dass das Kupfer die Todesursache darstelle, als geliefert ansehen. Beide Fälle sollen durch Verwendung von Kupfergeschirren zu erklären sein; der eine könnte ebensogut eine Ptomaïnvergiftung, der andere sehr interessante, bei dem 4 Personen in wenigen Stunden starben, eine Kohlenoxydvergiftung darstellen.

VII.

Lässt sich durch das Bisherige darthun, dass beim gesunden Erwachsenen schwere akute ökonomische Kupfervergiftungen kaum eintreten können, so mag gerne zugegeben werden, dass das Erbrechen, das auf die Einnahme grosser Dosen folgt, gelegentlich bei geschwächten Individuen, namentlich schwachen Greisen, zufällig eine schwere Störung der Herzfunction, Collaps u. dergl. auslösen kann. Hier hat das Kupfer aber keineswegs specifisch, sondern nur wie ein einfaches Brechmittel gewirkt.

VIII.

Es handelt sich nun noch um die Frage der chronischen Kupfervergiftung. Die Zeiten, in denen die übertriebenen kritiklosen Schilderungen von der Häufigkeit chronischer Kupfervergiftungen

namentlich bei Fabrikarbeitern geglaubt wurden, sind längst vorüber. Die Gastropathia cuprica febrilis, die Colica aeruginis, die Kupferlähmung sind jetzt entweder als seltene Krankheiten erklärt—oder der Zusammenhang derselben mit dem Kupfer wird gar ganz geleugnet, und Blei, Zink, Cadmium, Kohlenoxyd und andere chemische eventuell auch physikalische Schädlichkeiten als wahre Krankheitsursache betrachtet.

Eigene Erfahrungen habe ich an Kupferarbeitern keine sammeln können, kann aber durch die Güte des ausgezeichneten Kenners der Gewerbekrankheiten, Medicinalrath Dr. Merkel in Nürnberg, mittheilen, dass derselbe trotz der grossen Bronceindustrie in Fürth, bei der die Arbeiter von Broncestaub ganz vergoldet und versilbert sind, *nie* eine Kupfervergiftung gesehen hat. Hirt's Erklärung der Kupferkolik als akute Kupfervergiftung bei unreinlichen Kupfer- (Grünspahn-) Arbeitern erscheint mir recht annehmbar, um einen Theil der Fälle, wo man mit der Annahme einer Vergiftung durch andere Metalle nicht auskommt, zu erklären. Für einige wenige in der Litteratur immer wieder abgedruckte Fälle: Kupfervergiftung bei einem Buchbinder durch Vergolden der Bücherrücken mit unächtem Gold, bei einem Manne durch ein in Kupfer gefasstes Gebiss, ist nur die Annahme einer besonderen ganz räthselhaften Idiosynkrasie möglich, wenn nicht auch hier irgend eine falsche Deutung vorliegt.

Von einer chronischen Vergiftung durch kupferhaltige Nahrungsmittel (Brot, Conserven) enthält die Litteratur keinen einzigen gut beobachteten Fall, dagegen ass Galippe experimenti causa 14 Monate mit seiner Familie blos in Kupfer zubereitete und häufig darin erkaltete Speisen ohne jeden Schaden.

Ich selbst habe, um mir über die älteren Erfahrungen von Toussaint, Du Moulin u. A., an Thieren und Menschen ein objektives Urteil zu bilden, langdauernde Fütterungsversuche mit meinen Schülern an 6 Kaninchen, 4 Katzen und 1 Hunde angestellt. Es wurden dabei, nachdem die Thiere sich in einigen Tagen an den Kupfergehalt der Nahrung durch kleine Dosen (10–30 mg. Kupfer) gewöhnt hatten, meist Dosen von 50, häufiger noch von 100 mg. Kupfer gefüttert und die Versuche 2–4, einmal 6 Monate fortgesetzt.

Es wurde Sulfat, Acetat, Chlorid, Oleat, Butyrat, Lactat ohne jeden Unterschied der Wirkung verwendet.

Die Salze wurden stets vollkommen mit der Nahrung gemischt und ihre Aufnahme controlliert. Abgesehen von gelegentlichem Erbrechen und bei der Section einigemal entdecktem Magenkatarrh waren die Thiere ganz wohl, speciell auch die Nieren gesund. Ein Theil der Thiere zeigte sogar beträchtliche Gewichtszunahme. Nervöse Symptome, Krämpfe, Lähmungen, Diarrhoen, Obstipationen wurden nie beobachtet. Dagegen wies die Analyse der Organe eine bedeutende Kupferresorption nach, die Lebern der Katzen enthielten durchschnittlich 12 mg. Kupfer, auch in den übrigen Organen war etwas mehr Kupfer als bei akuten Intoxicationen zu finden.

Trotz der Versuche von Toussaint und Galippe am Gesunden und so vieler interessanter Erfahrungen an lange Zeit mit hohen Kupferdosen behandelten scrophulösen und nervenkranken Personen, erschien es mir erwünscht auch am gesunden Menschen nochmals Erfahrungen zu sammeln.

Es nahmen daher 2 meiner Schüler nochmals täglich in Bier kleine Kupfermengen, der eine als Sulfat, der andere als Acetat:

Herr M	50 Tage	10 mg.	Cu =	39 mg.	Kupfersulfat
dann	30 „	20 „	=	78	„
Herr K	3 „	5 „	=	16 mg.	Kupferacetat
	10 „	10 „	=	32	„
	1 „	15 „	=	48	„
	19 „	20 „	=	64	„
	18 „	30 „	=	96	„

Beide Herren beobachteten nicht ein einziges mal die leiseste Störung an sich weder während des Einnehmens noch nachher. Ich wählte die Dosen absichtlich kleiner, als sie zu therapeutischen Zwecken genommen zu werden pflegten, da ich auch jede Magenbelästigung vermeiden wollte.

Soweit man nach 2- bis 3-monatlicher Versuchsdauer einen Schluss ziehen kann, muss ich mich unumwunden dahin aussprechen: Die Versuche am Menschen mit kleinen Kupferdosen sprechen auch bei uns absolut gegen die Möglichkeit einer chronischen Kupfervergiftung, durch die im Haushalt vorkommenden Mengen.

Es sei mir noch gestattet, aus einem schon recht umfangreichen und mühsam gewonnenen Zahlenmaterial hier noch einige theoretisch interessante Daten vorläufig mitzutheilen: Von mittleren Kupferdosen, die man einnehmen lässt, werden einige Procent resorbiert (von kleinen Dosen mehr, von grossen weniger); leichte Magenanätzung scheint ohne Bedeutung für die Resorptionsgrösse; die grösste Menge des offenbar vorwiegend aus dem Darme resorbierten Kupfers wird vorübergehend in der Leber deponirt, der Hauptausscheidungsweg für das Kupfer scheint beim Hunde die Leber, beim Kaninchen der Darm, beim Menschen die Niere.

Für den Menschen haben wir speciell durch zahlreiche sorgfältige Analysen dargethan, dass nach Einnehmen von 30 mg. Kupfer im Harn in 3 Tagen zusammen circa 4–5 mg. erscheinen, über die Ausscheidung durch Darm und Galle lässt sich beim Menschen natürlich nichts weiteres sagen.

IX.

Von diesen Erwägungen geleitet, ist eine directe Schädigung akuter oder chronischer Art von *den* Kupfermengen nicht zu befürchten, wie sie durch maassvolle und kunstgerechte Reverdissage, Brotbereitung mit Kupfer, und etwas sorglose Benützung kupferner Gegenstände im Haushalt in den Körper gelangen; dagegen können durch grob

nachlässig hergestellte Conserven oder Brot und absolut nachlässig behandelte Kupfergeschirre recht wohl Erbrechen, vielleicht auch einmal Brechdurchfall, aber kaum *mehr* entstehen.

Die Hygiene wünscht ein Verbot der Verwendung von Kupfer zur Färbung von Gemüseconserven, weil:

a. die Gefahr des Missbrauchs (des nachlässigen Zusatzes zu grosser d. h. schädlicher Mengen) vorliegt;

b. weder Haltbarkeit noch Geschmack der Conserven dadurch gewinnt;

c. kein Grund vorliegt die Conserven grüner zu färben als die frisch gekochten Gemüse.

Die Hygiene hat also ein Interesse daran, den nutzlosen Kupferzusatz zu Gemüsen überall zu verbieten; der Uebertreter dieser Vorschrift wird aber nur dann "wegen einer möglicherweise eintretenden "Beschädigung der menschlichen Gesundheit" zu bestrafen sein, wenn wirklich bedeutende Mengen Kupfer in die Gemüse eingeführt sind. Der Zusatz *kleiner* Mengen, etwa 20–30 mg. pro Kilo, wird nur aus nicht hygienischen Gründen, wenn man will "als scheinbare Verbesserung," als "Täuschung über die Qualität" u. dergl. zu bestrafen sein.

Der Zusatz von Kupfer zu Brot ist stets absolut zu verbieten, weil:

a. die Gefahr des nachlässigen Zusatzes zu grosser gesundheitsschädlicher Mengen vorliegt;

b. verdorbenes, unter Umständen schädliches, verdorbenes Mehl wieder backfähig wird;

c. ein vermehrter Wasserzusatz (6–7 %) möglich wird.

Kupfergeschirre sollen nicht zum Aufbewahren fetter, saurer oder gesalzener Speisen dienen.

Damit ist Alles geschehen, um auch die leichten Kupferschädigungen auszuschliessen.

Die gerichtliche Medicin hat die Pflicht, viel mehr als dies heute noch geschieht, bei angeblichen schweren Kupfervergiftungen durch Speisen quantitative Ermittelungen anzustellen, um darzuthun, ob denn wirklich allermindestens 200 Milligramm Kupfer von dem Vergifteten genossen sind. Lässt sich dieser Beweis nicht führen, so ist an eine Kupfervergiftung bei einem Erwachsenen nicht zu denken, vielmehr durch Anamnese und Analyse nach Ptomaïnen oder Toxalbuminen zu fahnden. Für eine tödtliche Kupfervergiftung am gesunden Erwachsenen sind nach unseren Kenntnissen mindestens 1200 mg. Kupfer nöthig.

DISCUSSION.

The President briefly recapitulated the chief points of Professor Lehmann's Paper in English, and pointed out the great value of the results therein described.

Mr. Goodfellow remarked that, having had occasion within the last three years to examine a large number of samples of English bread for adulterants, he was enabled to say that no case of adulteration with copper sulphate had come under his notice. He had, however, examined seven specimens of Dutch bread, and had found traces of copper sulphate in four cases.

Mr. Cassal said that copper had not been found in bread by British public analysts, so far as he was aware, since the passing of the "Sale of Food and Drugs Act, 1875." If it ever existed as an adulterant of bread, it must have been some time before the passing of that Act. There had recently been a conviction at Glasgow for selling tinned peas containing copper.

Dr. H. G. Colman asked Professor Lehmann whether he believed that tin, as well as copper, had not the great poisonous effect usually ascribed to it. Most of the cases of poisoning from tinned meats which had been ascribed to tin-poisoning really appeared to be due to ptomaines.

Dr. W. J. Russell, F.R.S., believed that the bad character of copper had been gained owing to the ease with which it is detected in small quantities in chemical analysis, and alluded to the curious fact that considerable quantities of copper were contained in the two red tail-feathers of the Touracon.

Professor Lehmann, in reply to Dr. Colman, stated that tin, when taken in small quantities for a length of time, had, undoubtedly, an ill effect upon the system, but believed that all the supposed acute cases of tin-poisoning were in reality caused by ptomaines.

The Action of Water on Lead.

BY

J. H. Garrett, M.D., D.P.H.

The subject of the action of water on lead has a special hygienic interest on account of its resulting in the contamination by lead of drinking-water.

In the Gulstonian Lectures, delivered in the early part of the present year before the Royal College of Physicians of London, Dr. Thomas Oliver has treated the subject of lead poisoning in an exhaustive manner, and to his treatise reference can be made for information upon the pathological effects likely to accrue from imbibition of this metal and its salts.

The chemical aspect of the question, which at present concerns us, has received the attention of several experimenters, but the want of agreement noticeable in their results has led to a confusion rather than to a settlement of the matter. I venture to suggest that this has been mainly due to the different ways in which the experiments have been conducted, and to the bias in favour of the acid, which is sometimes con-

tained in natural waters that act on lead, being in some way the cause of the action.

By the observations I have made upon the action of a great many waters, I am convinced, and cannot think there is room for doubt, that the primary action of water on lead is in every case a process of oxidation. Thus, the invariable result of putting lead into contact with water neutral or faintly alkaline in reaction, such as most distilled waters, is the production of a colourless crystalline oxyhydrate of lead that is almost insoluble in pure water. I have recently had under examination numerous samples of soft waters from the Devonshire rivers, &c., and have found that they act upon lead in a manner practically identical with the action of distilled water, and a similar effect may commonly be obtained from rain water. In each case solid oxyhydrate of lead is rapidly produced, and falls off the lead as it is formed, leaving a fresh surface to be acted upon. The air being admitted to the surface of the water, this action is continuous, lasting for weeks or months, or until the lead is buried in the deep layer of oxyhydrate produced.

With the action of these neutral or faintly alkaline waters, let us contrast the action of a decidedly acid water. Naturally acid waters are found in connexion with peat and otherwise, but the composition of the acid which these peat waters contain is at present unknown. When one of these acid waters is placed in contact with lead we get a clear solution of lead salt as an immediate result; but, doubtless, the lead is oxidized before being dissolved by the acid. The amount of acid present of course determines the amount of lead that can be dissolved. The action does not necessarily stop here, however, but the oxidation of the lead may continue beyond the point of saturation of the acid, and the extra oxide formed, or a part of it, combining with the neutral salt in solution forms an oxysalt. This oxysalt being less soluble than the neutral salt, less lead is now contained in solution; a portion of that at first dissolved now forming part of the deposit that lies upon the bottom of the vessel or upon the surface of the lead. When the acid in the water is very small in quantity the usual production of oxyhydrate of lead is only delayed for a short time. When a much more appreciable quantity of acid is contained in the water, the oxysalt which is thrown out of solution and deposited, or formed, upon the surface of the lead, tends to adhere firmly, and covering the lead protects it and thus brings the action to a termination. By a very careful neutralisation of the acid, the production of solid oxyhydrate may be made to commence immediately, just as it does in waters that are naturally neutral or nearly so. The oxyhydrate of lead itself gives the water an alkaline reaction, and the reaction of every water that is acting on lead is therefore destined to become alkaline ultimately, the only factor necessary for the continuous oxidation of the lead being a constant supply of oxygen.

Waters which are decidedly alkaline by reason of containing considerable quantities of a carbonate, such as calcium carbonate, including

those that deserve in any degree the title of hard waters, are prevented from acting on lead by the formation upon the surface of the metal of a closely fitting insoluble coat or film, which is presumably a basic carbonate of lead. The carbonic acid which ordinarily acts as a solvent to the carbonate of lime in hard waters, does not leave the carbonate of lime to dissolve carbonate of lead; but unusual waters may exist in which there is a very large excess of carbonic acid gas over that required to hold in solution the calcium carbonate, and the formation and solution of carbonate of lead may then be expected. Such a water must be included amongst the acid waters, and there is no acid water that so well exemplifies the effect of the continued oxidation at the surface of the lead, in causing the ultimate precipitation of the soluble lead salt at first formed, as distilled water into which carbonic acid gas has been passed. As will be seen in the following table, the solution becomes stronger until it contains lead in the proportion of 2·8 millegrammes per litre; but after 20 hours' further exposure the strength is reduced to ·14 millegrammes per litre.

TABLE showing the Amount of Lead dissolved by Distilled Water into which CO_2 has been passed.

Time exposed.	Lead in Solution.
3 hours	·94 millegrammes per litre.
10 „	2·8 „ „
30 „	·14 „ „

It has been stated by some authors that carbonic acid gas dissolves lead; by others, that it coats lead and prevents the action of water upon the metal. It does both; first the one, and then the other. For carbonate of lead is first dissolved by excess of CO_2; but this excess of CO_2 is presently neutralised by further production of oxide of lead. A great part of the lead at first dissolved is withdrawn from solution, and a basic carbonate is formed upon the surface of the lead which, protecting it from the water, causes cessation of action. The coat which carbonic acid gives to lead in this way is a soft white fur, quite different from the closely fitting film that is formed upon it when an alkaline carbonate is contained in the water. A fur similar in appearance, composed of basic salt, covers the lead as an ultimate result of the action of waters containing other acids, such as nitric, hydrochloric, or sulphuric, which in limited proportion have been purposely added to the water, or the acid naturally contained in peaty waters when it exists in them in sufficient quantity. The fact of a water containing certain neutral salts other than carbonate, such as sulphate, also leads to the formation of a similar fur upon the surface of the lead, a reaction between the oxyhydrate of lead and the sulphate of calcium, &c. evidently taking place. The presence of sulphate, chloride, &c. causes more lead to be retained in solution, and ammonia salts do the same thing in a particular degree, especially nitrate of ammonia. Sulphate diminishes the rate of production of oxyhydrate of lead, or puts an end to its production altogether by

clogging the surface of the lead with basic salt of slight solubility that does not fall off the surface of the metal as do the fine crystals of the oxyhydrate itself. The presence of chloride appears to increase the rate of oxidation of lead. Phosphate and silicate have some power in causing a closely fitting insoluble film to be formed on the surface of the metal which has influence in protecting it from further action of water; but the protective coat afforded by these salts does not form so quickly and perfectly as in the case with that formed by carbonate.

The rate of action of water on lead, whether the water be acid or faintly alkaline, is increased in a marked manner by increase of temperature, perhaps up to 70° C.; but above that temperature a comparatively slight and limited action takes place. In my experiments I have got the most marked results at about 50° C.

I am desirous of making it plainly understood that it is in waters that are nearly neutral in reaction that the production of lead salt occurs with greatest rapidity and continues with the least interruption; and lead may generally be found in such waters when they are conveyed through leaden pipes. It is not dissolved, but exists in a state of suspension. The minute crystals of oxyhydrate lend themselves very readily to suspension, and when suspended in a water may be easily overlooked, unless the water be critically examined in a good light. The lead when existing in water in this condition, has no doubt sometimes been taken to be dissolved. The practical effects are much the same as if it were dissolved; but it is well to make the distinction in considering the cause of the action of water on lead.

The action consisting primarily and chiefly in the oxidation of the metal, we are at the root of the matter when we begin to consider whence and how the oxygen is derived. What are the possible sources of oxygen? *a*. The free oxygen that is dissolved in the water. *b*. Oxygen that may be derived by decomposition of water, either by the lead itself displacing hydrogen, or by an electrolysis due to voltaic action resulting from the fact of common sheet and pipe lead being invariably alloyed with small quantities of other metals. *c*. Oxygen derived by reduction of the nitrates and nitrites, or other forms of oxidised nitrogenous matter, which occur in most waters to a greater or lesser extent.

If a water be obtained that has not the power of acting on lead, even though it contain no carbonate, &c. to obstruct the action (and such a water is occasionally met with) no amount of aëration will cause the action to start, or increase it where it only occurs in a slight degree. If a distilled water, which has been found to act on lead in the cold with rapid and continuous production of oxyhydrate, be placed in a platinum dish and boiled for five minutes, we may take it for granted that the whole of the free oxygen is dissipated. Now if without allowing the water to cease boiling we drop in pieces of clean lead, there should be no lead salt formed provided the action be wholly due to free oxygen. But a limited, yet decided quantity of lead salt is formed, giving the water

an opalescence and a flocculent deposit. This initial action cannot be due to free oxygen. But if it be thus proved that action can take place when the absence of free oxygen is assured, it is quite as easy to prove that a *continuous* oxidation of the lead cannot take place unless air be admitted to the surface of the water. A water which acts on lead with production of oxyhydrate being placed in an appropriate vessel along with pieces of clean lead, melted paraffin wax or oil is poured over the surface of the water, and the air is thus shut out. A check experiment is at the same time made with water and lead in the same proportions, but with the air freely admitted to the surface of the water. In the former, action occurs and proceeds for a time, and then abruptly comes to an end. In the latter, similar action occurs, and the two keep pace for a time equally with each other; but in this, the action continues after it has ceased in the other, so that at the end of a week the lead salt formed in it is vastly greater than that which has been formed in the one from which air is excluded. From this observation we are forced to the conclusion that whatever may be the initial cause of the action, the continuation of it beyond a certain point is certainly dependent upon absorption of oxygen from the air.

The fact of the action requiring for its continuance, but not for its commencement, a supply of air, proves of itself that the action is not due to a decomposition of water either by a simple displacement of hydrogen by lead, or by electric influence. Besides this, at common temperatures, the action of water on lead does not result in any evolution of hydrogen, and it would not be possible for decomposition of water to proceed for any length of time without hydrogen being evolved. In regard to the production of an electric current by reason of the impurity of the lead, samples of pure metal, that is, as pure as could be obtained by igniting either of several carefully prepared plumbic compounds in a porcelain crucible, were found to have an action upon water precisely similar to the commercial metal. Silver is the metal that is most likely to exist in lead in such quantity as to cause any effect of practical importance in the action of water upon it. The minute traces of copper and other metals that may occur can have little appreciable effect. I have made experiments into the effects upon the oxidation of lead of coupling different metals along with it before immersing it in the water. Strips of foil of the several metals, of equal surface, were taken, and strips of lead were coupled with similar strips of each of the other metals by merely hooking and bending their ends together, so that the two metals formed a ring, half of which was of lead and half of the other metal. A check experiment being made with one of the pieces of lead-foil alone, the amount of lead salt formed from the lead alone, could be compared with that formed by each couple. The lead used was a thick lead-foil, supplied by Messrs. Hopkin and Williams, of Hatton Garden, which was stated to be pure lead. Some of the other metals were supplied by the same firm in the form of thick foil. The following results were obtained. The experiments were performed simultaneously, and equal measures of water were used. Temperature averaged about 17° C.

Experiment I.—The water used was distilled water with a slightly alkaline reaction. The metals were in the water 12 hours, being wholly immersed.

Metals employed.	Relative Amount of Lead converted into Lead-salt.
Lead alone	100
Lead and silver	120
Lead and copper	108
Lead and iron	100
Lead and aluminium	16
Lead and tin	14
Lead and zinc	6

Thus the silver and copper coupled with lead caused a slight increase of action on the lead in this alkaline water, whilst aluminium, tin, and especially zinc, caused a marked diminution. The silver and copper did not themselves appear to be affected, but some oxidation of the iron and other metals took place.

Experiment II.—The water used was distilled water, made very faintly acid with acetic acid. The metals were in the water three hours, wholly immersed as before.

Metals employed.	Relative Amount of Lead converted into Lead-salt.
Lead alone	100
Lead and copper	150
Lead and silver	133
Lead and iron	7
Lead and zinc	5
Lead and aluminium	0
Lead and tin	0

Coupling with aluminium and tin wholly prevented the oxidation of lead in this water whilst coupling with copper and silver again increased it. The silver and copper themselves appeared unaffected, but the other metals could be detected in the respective waters.

Experiment III.—The water used was as in last experiment, but was made more strongly acid with acetic acid. It contained, in fact, about ¼ per cent. strong acetic acid. The metals were immersed in the water 12 hours.

Metals employed.	Relative Amount of Lead converted into Lead-salt.
Lead alone	100
Lead and aluminium	7
Lead and tin	7

Experiment IV.—The water was a peaty water from Dartmoor, with a naturally acid reaction. The metals were immersed in the water three hours.

Metals employed.	Relative Amount of Lead converted into Lead-salt.
Lead alone	100
Lead and silver	300
Lead and copper	150
Lead and tin	70
Lead and zinc	70

With this water the zinc and tin did not appear to prevent action on lead in such a marked way as in previous experiments. The action was, however, increased to a greater extent by copper and silver.

It is a rare thing to meet with a water that is absolutely nitrate free; and as lead reduces nitrate at common temperature when contained in solution in a water, however minute a proportion be present, we have here an undeniable source of oxygen. Every nearly neutral water that acts on lead with production of crystals of oxyhydrate, and every naturally acid water that acts on lead with solution of the oxide, gives evidence of containing nitrite after the action has taken place. As the water did not contain nitrite in the first place, or if it contained nitrite the quantity is now increased, we are right in assuming that it has been produced by reduction of nitrate by the lead. In the hundreds of experiments that I have made upon the action of water on lead, in no case where the ordinary action has occurred have I failed to obtain ample proof of the presence of nitrite after the action. But although lead reduces nitrate to nitrite (and when air is excluded probably to hyponitrite) it never reduces it entirely to ammonia at common temperature. The reduction apparently does not take place with sufficient rapidity for this to happen; and unless water be decomposed, there is no hydrogen to form ammonia with the nitrogen of the nitrate. When there is free admission of air the nitrite is reoxidised by the oxygen of the air as fast as it is reduced by the lead.

The main action of water on lead is therefore due to the presence in the water of a nitrate (or some partially oxidised organic nitrogenous compound which admits of being reduced by the lead and reoxidised by the air giving the reaction of nitrite when reduced). The continuation of action observed to take place in a nearly neutral water, where oxyhydrate of lead is produced for weeks together, is due to nitrite acting as an oxygen carrier between the air and the lead. The rate of action is increased when copper, silver, and other metals are in contact with the lead beneath the water. The rate is diminished when zinc, tin, and other metals are similarly in contact with it, these metals suffering oxidation in preference to the lead.

Experiment I.—The water used was distilled water alkaline reaction. The metals were in the water 12 hou immersed.

Metals employed.	Relative Am converted in
Lead alone	1(
Lead and silver	1:
Lead and copper	1(
Lead and iron	1(
Lead and aluminium	1
Lead and tin	1
Lead and zinc	

Thus the silver and copper coupled with lead caused of action on the lead in this alkaline water, whilst alu especially zinc, caused a marked diminution. The silve not themselves appear to be affected, but some oxidation other metals took place.

Experiment II.—The water used was distilled faintly acid with acetic acid. The metals were in the w wholly immersed as before.

Metals employed.	Relative A converted
Lead alone	
Lead and copper	
Lead and silver	
Lead and iron	
Lead and zinc	
Lead and aluminium	
Lead and tin	

Coupling with aluminium and tin wholly p of lead in this water whilst coupling with copper a it. The silver and copper themselves appeared u metals could be detected in the respective waters.

Experiment III.—The water used was as was made more strongly acid with acetic acid about ½ per cent. strong acetic acid. The met. water 12 hours.

Metals employed.	R
Lead alone	
Lead and aluminium	
Lead and tin	

DISCUSSION.

Dr. Rideal asked whether the reduction of nitrate to nitrite took place in the experiments cited by Dr. Garrett, only when a "couple" of two metals was employed; and if the reduction was continued to ammonia; as with a copper-zinc couple the presence of nitrite, and therefore of an oxygen carrier, would be prevented?

Mr. W. R. Maguire (Dublin) said that in Dublin the public water supply from the Vartry River is a very pure one, resembling the Glasgow water from Loch Katrine. Fifteen years ago it was discovered that lead pipes and cisterns were attacked by this water, and the Corporation, in order to prevent lead poisoning, ordered that all lead pipes for water should contain 3 per cent. of tin. This had been carried out for 15 years without any case of lead poisoning attracting attention. Sir Charles Cameron found that small carp placed in the lead tanks showed signs of paralysis which so cramped their bodies that it caused them to miss their food as they darted at it. In tanks made of lead alloyed with 3 per cent. of tin this did not occur. Mr. Maguire inquired whether this alloy would give absolute security against lead poisoning. Small iron pipes could not be used to convey Vartry water, as the pipes were choked within a few months.

Dr. Russell mentioned a case in which a very pure water had dissolved a large amount of zinc from the containing tank.

What is the Importance of Magnesia in Drinking Water?

BY

PERCY F. FRANKLAND, Ph. D., B. Sc. (Lond.), F.R.S., Professor of Chemistry in St. Andrews University, Dundee.

It must be confessed that in spite of the enormous amount of attention which has for years been devoted to the chemical analysis of drinking water, we are still lamentably ignorant of the precise hygienic importance of the mineral constituents which analysis reveals. Indeed the diversity of opinion regarding these mineral substances is far greater than concerning the more obscure and less easily handled organic matters of drinking-water. Thus some authorities actually prefer waters containing a very considerable proportion of mineral matters, others object to such waters, and others again regard the matter with complete indifference. Phosphatic calculi, goitre, and cretinism have been by some referred to waters containing lime and magnesia salts, whilst others have adduced evidence that such disorders are wholly unconnected with hard water. This question of the relative fitness of hard and soft water for drinking purposes was submitted to

investigation by the Rivers Pollution Commission of 1868, who, after devoting no less than 16 pages to a critical review of the evidence before them, leave the matter in the supremely unsatisfactory condition indicated by the following words:—

> "We are, therefore, of opinion that whilst waters of excessive hardness may be productive of calculous and perhaps other diseases, soft and hard waters, if equally free from deleterious organic substances, are equally wholesome."

The said Commissioners are, however, entirely silent on the subject of magnesia; indeed amongst the innumerable analyses of potable water which occur in their Sixth Report there is, I believe, only one in which the magnesia is recorded at all. This is in the case of the water supplied from a deep well in the magnesian limestone to Sunderland, which is said to contain 3·96 parts of magnesia (MgO) per 100,000.

Within recent years there has however, arisen in certain quarters in this country a belief that magnesia when present in more than a very limited quantity is objectionable, and I am acquainted with at least one case in which an otherwise unimpeachable water was discarded in consequence of its containing a few grains of magnesia per gallon.

This view is the more open to question in consequence of the very limited information which is available concerning the proportions of magnesia which are commonly met with in British potable waters. The determination of magnesia is one of the most laborious which occur in water examination, and is consequently but rarely undertaken by water analysts; from time to time, however, I have had occasion to determine the magnesia in waters which have been submitted to me, and I think that it may not be without interest to place on record some of the results which I have obtained more especially on this occasion, so that the proportions met with in British waters may be compared with those found on the Continent where the magnesian formations are much more largely represented.

In the accompanying table, pp. 84 and 85, I have recorded the results of analysis of a number of typical samples, which serve to illustrate the proportions of magnesia found in the supplies obtained from some of the more important water-bearing strata of great Britain.

These analytical results show that the calcareous waters derived from the chalk contain only a very small proportion of magnesia, and that even in the highly saline waters obtained from the chalk below the London Clay the amount is also very moderate, only distinctly greater than in the case of the normal chalk waters.

The proportion of magnesia, again, is considerably greater in the water from the lias, as represented by the wells at Wellingboro', whilst the largest proportions were found in waters from the magnesian limestone and new red sandstone.

[ANALYTICAL TABLE.]

RESULTS OF ANALYSIS EXPRESSED IN PARTS PER 100,000.

Description		Total solid Matters.	Organic Carbon.	Organic Nitrogen.	Ammonia.	Nitrogen as Nitrates and Nitrites.	Total Combined Nitrogen.	Chlorine.	Hardness. Temporary.	Hardness. Permanent.	Hardness. Total.	Remarks.
Spring water from Newark-on-Trent, used for brewing purposes -	(II.)	257·05	·046	·013	0	·465	·478	2·9	17·2	162·8	180·0	
		Fe_2O_3 and Al_2O_3		CaO	MgO	Na_2O	SO_3	N_2O_5	SiO_2	—	—	
		·14		82·89	14·74	4·68	131·51	1·79	·98	—	—	
Pontefract water supply from Magnesian limestone.	(I.)	88·84	·035	·010	0	3·315	3·325	5·9	16·6	37·2	53·8	Total MgO = 9·23.
Well in bunter beds of new red sandstone at Sandiacre, Derbyshire.	(I.)	45·04	·097	·037	·021	·094	·148	2·0	19·5	18·7	38·2	Total MgO = 7·05. Total CaO = 10·78.
Spring at Matlock Bath, Derbyshire.	(I.)	47·84	·021	·002	0	·030	·032	4·1	18·8	15·3	34·1	Total MgO = 4·08. Total CaO = 11·37.
Bore-hole in alluvium near River Derwent, Matlock Bath.	(I.)	24·44	·117	·048	·020	0	·064	·9	9·0	8·2	17·2	Total MgO = 2·53. Total CaO = 5·60.
Boring in new red sandstone at Gainsborough, Lincolnshire.	(I.)	49·97	·028	·008	0	0	·008	2·0	16·8	18·6	35·4	
	(II.)	·19		11·94	5·97	2·84	16·62	0	·94	—	—	
Waters from Malvern:												Total:—
No. 1. - -	(I.)	27·48	·092	·024	0	·668	·692	1·9	11·6	9·6	21·2	Magnesia = 4·09.
No. 2. - -	(I.)	8·52	·045	·016	0	·354	·370	1·2	0	4·3	4·3	Ditto = ·75.
No. 3. - -	(I.)	12·56	·033	·014	0	·277	·291	1·5	2·9	5·0	7·9	Ditto = 16·4.

Description - (I.).	Total solid Ma	Organic Carb	Organic Nitr	Ammonia.	Nitrogen Nitrates a Nitrites.	Total Combi Nitrogen.	Chlorine.	Temporary.	Permanent.	Total.	Remarks.
Wells at Wellingboro' before softening - (I.)	58·20	·036	·017	·004	0	·020	2·2	30·3	16·2	46·5	
(II.)	Fe_2O_3 and Al_2O_3		CaO	**MgO**	Na_2O	SO_3	N_2O_3	SiO_2	—	—	
	·35		21·97	**4·05**	2·31	11·30	0	1·01	—	—	
Ditto after softening with lime - - (I.)	26 30	·035	·014	·004	0	·017	2·2	1·1	14·9	16·0	
(II.)	·02		6·42	**2·16**	2·24	12·03	0	·63	—	—	
Well in chalk, Southampton, before softening - - (I.)	31·69	·024	·012	·005	·365	·381	1·6	23·0	2·7	25·7	
(II.)	·14		14·53	**·25**	1·21	·39	1·41	1·02	—	—	
Ditto after softening with lime - - (I.)	14·07	·021	·013	·004	·381	·397	1·6	5·6	3·0	8·6	
(II.)	·11		4·42	**·28**	1·12	·45	1·47	·94	—	—	Total **MgO** = **·92.** Total CaO = 12·35.
New River Company's water, London, before softening. (I.)	32·08	·150	·018	0	·308	·326	2·1	19·1	3·6	22·7	
Ditto after softening with lime. (I.)	13·48	·103	·017	0	·329	·346	2·1	1·9	3·4	5·3	Total **MgO** = **·80.** Total CaO = 2·14. Alkalinity (calculated as Na_2O) = 8·69.
Well in chalk below London clay, London - - (I.)	59·29	·036	·013	·010	0	·021	8·3	10·0	0	10·0	
(II.)	·20		3·20	**1·97**	24·85	11·41	0	1·25	—	—	
Well in chalk below London clay, Victoria Dock, London, before softening (I.)	58·76	·111	·017	·050	0	·058	16·7	19·8	8·0	27·8	
(II.)	·22		12·57	**2·82**	13·13	3·96	0	1·44	K_2O =	·93	
Ditto after softening with lime and caustic soda - - (I.)	44·20	·084	·016	·060	0	·065	17·3	2·4	6·0	8·4	
(II.)	·14		5·96	**·57**	15·76	4·01	0	·69	K_2O =	1·06	
Deep well in new red sandstone at St. Helens - (I.)	56·40	·099	·029	·004	0	·032	3·6	29·4	11·8	41·2	
(II.)	·15		15·76	**6·31**	5·82	7·33	0	·97	K_2O =	·33	
Ditto after softening with lime - - (I.)	—	—	—	—	—	—	—	—	—	15·7	
(II.)	—	—	4·25	**5·41**	—	—	—	—	—	—	

It will be further seen that in all cases in which the proportion of magnesia is at all considerable (say, upwards of four parts), the permanent hardness is high (10 parts per 100,000 or upwards), whilst in none of the cases quoted is the permanent hardness above 10 without the magnesia being above four parts; in fact, in waters with low permanent hardness there is little chance of finding much magnesia, and *vice versâ*. Applying this rule, it will be found that in all probability an immense number of waters in common use must contain from four to six parts of magnesia per 100,000, a proportion which by some authorities is regarded as objectionable. Thus, of 28 samples of deep-well water from the new red sandstone analysed by the Rivers Pollution Commission, no less than 16 or more than 50 per cent. contained upwards of 10 parts of permanent hardness. Again, of 15 spring waters from the new red sandstone, seven exhibited upwards of 10 parts of permanent hardness. On the other hand, of 66 deep-well waters from the chalk, only five or 7·5 per cent. had upwards of 10 parts of permanent hardness; and of 28 spring waters from the chalk there was not one in which the permanent hardness amounted to 10 parts per 100,000.

If this investigation be extended to shallow wells, it will be found that the number of probably magnesian waters becomes enormously greater. Thus, of 87 samples of shallow-well water from the new red sandstone, no less than 84, or 96·5 per cent. had their permanent hardness in excess, and generally largely in excess, of 10 parts per 100,000; and again, of 33 samples of shallow-well water from the chalk, 27 exceeded the 10 parts of permanent hardness. Thus, without at all forcing the rule as to the relationship between permanent hardness and magnesia, it is obvious that waters containing from four to six parts of magnesia must be of very common occurrence indeed, and that a very large portion of our population must be supplied with them. Until, therefore, a far more searching inquiry than hitherto has been made into the alleged effect of such waters upon health, it appears to me highly undesirable that any importance should be attributed to such proportions of magnesia in drinking water which are otherwise of unimpeachable purity.

In conclusion, I would call attention to the effect of Clark's process on magnesian waters, which is recorded in several cases in the table. As a general rule, the proportion of magnesia removed by the treatment with lime is small, much smaller than that of the lime removed, but it is particularly worthy of notice that in the case where caustic soda was used in conjunction with lime, as is now frequently done in the softening of water for industrial purposes, the proportion of magnesia removed was greater than that of the lime.

As the recorded determinations of magnesia in British waters are comparatively scarce, I have thought it desirable to append the proportions of lime and magnesia in a series of 50 brewery-waters which I have examined from all parts of the country, although in only a few instances am I able to assign the precise source of the samples.

BREWERY WATERS.

PARTS PER 100,000.

	Lime combined as Carbonate.	Total Lime.	Total Magnesia.
No. 1	11·96	18·21	·31
„ 2	7·49	7·74	3·90
„ 3	14·37	17·21	·20
„ 4	1·04	10·69	9·99
„ 5	13·91	20·67	·81
„ 6	3·36	6·26	2·24
„ 7	12·31	15·16	4·36
„ 8	3·24	6·34	1·34
„ 9	12·89	15·44	·76
„ 10	0	25·94	9·01
„ 11	16·27	20·46	1·81
„ 12	12·81	16·47	1·87
„ 13 (from Chapel-en-le-Frith, Derbyshire.)	0	1·04	·57
„ 14 (from Brighton)	14·06	20·87	1·11
„ 15 (Chalk below London clay)	2·81	2·81	1·33
„ 16 (from Cosham, Hants)	17·41	23·46	2·84
„ 17 (from Brighton)	10·30	13·69	·41
„ 18 „ „	11·51	16·39	·61
„ 19 (from Wrexham)	16·99	21·14	2·77
„ 20	6·40	10·74	·89
„ 21	10·37	10·69	6·21
„ 22	5·54	5·54	1·74
„ 23	9·53	11·13	·54
„ 24	13·11	15·67	·19
„ 25	2·84	3·37	1·40
„ 26	14·91	19·94	5·01
„ 27	5·91	7·16	1·07
„ 28 (from Reading)	15·90	25·57	1·21
„ 29	7·11	14·57	5·50
„ 30	20·26	23·04	8·81
„ 31	8·16	8·16	2·57
„ 32	14·51	17·00	7·36
„ 33 (from Cardiff)	5·04	14·86	3·91
„ 34	19·34	28·89	2·14
„ 35 (from Louth)	11·60	13·36	1·16
„ 36 (from Taunton)	9·79	10·16	1·27
„ 37	9·91	9·94	4·14
„ 38	9·36	11·87	·56
„ 39	13·94	15·21	·39
„ 40	·34	3·73	1·61
„ 41	17·64	32·56	5·99
„ 42	7·16	51·66	27·10
„ 43	12·71	46·60	20·57
„ 44	10·74	19·10	·60
„ 45	10·74	12·29	1·19
„ 46 (from Hertford)	12·61	14·37	·76
„ 47	·29	4·96	2·59
„ 48	10·04	11·00	3·03
„ 49	3·29	3·39	3·30
„ 50 (Chalk below London clay)	—	2·61	1·46

Average Magnesia = 3·41 parts per 100,000.

DISCUSSION.

Sir C. Cameron stated that the Dublin pipe-water was soft, containing only two grains of mineral matter per gallon. He found that soft lead pipes were sensibly affected by the water, and that small fish placed in tanks became affected or paralyzed. The waters in a large part of Ireland were hard waters, and contained magnesium as carbonate sulphate, and chloride. In many cases he had found from 3 to 10 grains of magnesium salts per gallon. The rock locally called calp, a limestone with large admixtures of aluminium silicates, silica, oxide of iron and iron pyrites, generally contained magnesia, often in large quantities. The Dublin well-waters were very rich in magnesium salts. He was not aware of any injurious influences upon health produced by these waters.

Dr. S. Barwise (Blackburn) stated that tinned lead pipes were quite satisfactory for soft peaty waters. The Blackburn water was very similar to the Dublin water; it acted on lead; but, owing to the Blackburn authority carefully insisting upon all lead pipes being lined with tin, they had no cases of lead poisoning.

Dr. T. M. Drown (Boston, U.S.A.) gave an account of the Massachussetts State Board of Health's investigations into the natural waters of the State, and described the establishment of isochlors or lines of equal chlorine-contents of the waters throughout the State.

Sir C. Cameron stated that in the soft waters in Ireland there was a relevancy between the amount of chlorine and pollution, but in the hard waters there was no such relevancy. Waters containing only 0·002 parts of albuminoid ammonia and 0·001 part of saline ammonia per 100,000 parts contained from 5 to 30 parts of chlorine per gallon.

The Importance of Periodic Analysis of the Air Breathed in Towns and Cities.

BY

K. N. Bahadurji, M.D., Bombay.

Good food, good water, and good air are the three necessary elements which conduce to and preserve the health of living units. All sound and healthy sanitation for the preservation of public health is based on principles which vouchsafe and safeguard the purity and wholesomeness of the supply of these three vital elements. In the words of Dr. Guy: "Public Hygiene has to do with persons of every "rank of both sexes and of every age. It takes cognizance of the places "and houses in which they live, of their occupation and modes of life, "of the food they eat, the water they drink, and the air they breathe." Man is able for himself to reject any article of food which is injurious to his health, yet in all large towns and cities it is regarded as a canon of sanitation to provide against unwholesome articles of food getting into the general food-supply; and to do this effectually sanitation has called in the aid of legislation, and rightly so. The provision of a pure

water-supply in towns and cities is everywhere acknowledged as a great sanitary duty, and, after a pure water-supply is provided, to maintain it in a state of purity is regarded as a sanitary obligation. It is rigorously insisted, and justly so, that no impurity shall be permitted to have access to such water, because the fouling of drinking water is often followed by fatal diseases. All the consideration which sanitation bestows on the water of towns and cities is no less required for the town and city air. It will not be disputed that of the three important elements for the preservation of health and life air is the most important one, and naturally so, considering the power for evil it possesses when in a state of impurity. The mortality produced by using noxious articles of food is trivial as compared with the deaths from diseases due to the drinking of impure water; and the mortality on the score of drinking impure water is considerably less—at least ten times less—than the mortality due to the breathing of impure air. The infant requires no water, but pure air, and more of it than the adult, inasmuch as respiration is most active in infantile life. Zymotic diseases, which destroy so much infantile life, are due in a considerable measure to impurities in the atmosphere.

If, then, the air we breathe, compared with the water we drink, has such a powerful influence, and that to such an extraordinary extent, for good or for evil, on the health and life of the population according as it is pure or impure, the preserving of the purity of the atmosphere, and the *preventing* its fouling, even with the help of legislation, has certainly the strongest claims on the sanitary duties and obligations of civilized towns and cities. And we should, therefore, expect to find in all well-supervised towns that the condition of the air was as closely and constantly watched as the condition of the water. Instead of this, what do we find? Carefully prepared periodic chemical examinations of the water-supply are made, and the results are made public. The people know the quality of the water provided for them. From time to time the health officer on the strength of his analyses recommends special measures for purifying the water before use. But there is no such periodic examination made of the atmosphere, and not one person in 10,000 knows anything of the condition of the air he breathes. The municipalities provide, at considerable expense, a water-supply of as pure a quality as can be obtained, and they take measures to maintain its purity. A pure air-supply is a provision of nature, and nature does try to maintain its purity. As soon, however, as population increases and a large number of dwellings are put up within limited areas, as occurs in towns and cities, the atmosphere necessarily gets vitiated to a certain extent; and the conditions of town and city life are inseparable from a somewhat polluted atmosphere. The expired air of human beings and animals is one constant source of pollution of nature's pure air. The dry sewage or garbage of cities, which is always accumulating as fast as it is carted away, is another source of pollution, and the decomposition of liquid sewage, whether in drains, sewers, or cesspits, is a third source of pollution. All these sources of pollution of town and

Experiment I.—The water used was distilled water with a slightly alkaline reaction. The metals were in the water 12 hours, being wholly immersed.

Metals employed.	Relative Amount of Lead converted into Lead-salt.
Lead alone	100
Lead and silver	120
Lead and copper	108
Lead and iron	100
Lead and aluminium	16
Lead and tin	14
Lead and zinc	6

Thus the silver and copper coupled with lead caused a slight increase of action on the lead in this alkaline water, whilst aluminium, tin, and especially zinc, caused a marked diminution. The silver and copper did not themselves appear to be affected, but some oxidation of the iron and other metals took place.

Experiment II.—The water used was distilled water, made very faintly acid with acetic acid. The metals were in the water three hours, wholly immersed as before.

Metals employed.	Relative Amount of Lead converted into Lead-salt.
Lead alone	100
Lead and copper	150
Lead and silver	133
Lead and iron	7
Lead and zinc	5
Lead and aluminium	0
Lead and tin	0

Coupling with aluminium and tin wholly prevented the oxidation of lead in this water whilst coupling with copper and silver again increased it. The silver and copper themselves appeared unaffected, but the other metals could be detected in the respective waters.

Experiment III.—The water used was as in last experiment, but was made more strongly acid with acetic acid. It contained, in fact, about ¼ per cent. strong acetic acid. The metals were immersed in the water 12 hours.

Metals employed.	Relative Amount of Lead converted into Lead-salt.
Lead alone	100
Lead and aluminium	7
Lead and tin	7

Experiment IV.—The water was a peaty water from Dartmoor, with a naturally acid reaction. The metals were immersed in the water three hours.

Metals employed.	Relative Amount of Lead converted into Lead-salt.
Lead alone	100
Lead and silver	300
Lead and copper	150
Lead and tin	70
Lead and zinc	70

With this water the zinc and tin did not appear to prevent action on lead in such a marked way as in previous experiments. The action was, however, increased to a greater extent by copper and silver.

It is a rare thing to meet with a water that is absolutely nitrate free; and as lead reduces nitrate at common temperature when contained in solution in a water, however minute a proportion be present, we have here an undeniable source of oxygen. Every nearly neutral water that acts on lead with production of crystals of oxyhydrate, and every naturally acid water that acts on lead with solution of the oxide, gives evidence of containing nitrite after the action has taken place. As the water did not contain nitrite in the first place, or if it contained nitrite the quantity is now increased, we are right in assuming that it has been produced by reduction of nitrate by the lead. In the hundreds of experiments that I have made upon the action of water on lead, in no case where the ordinary action has occurred have I failed to obtain ample proof of the presence of nitrite after the action. But although lead reduces nitrate to nitrite (and when air is excluded probably to hyponitrite) it never reduces it entirely to ammonia at common temperature. The reduction apparently does not take place with sufficient rapidity for this to happen; and unless water be decomposed, there is no hydrogen to form ammonia with the nitrogen of the nitrate. When there is free admission of air the nitrite is reoxidised by the oxygen of the air as fast as it is reduced by the lead.

The main action of water on lead is therefore due to the presence in the water of a nitrate (or some partially oxidised organic nitrogenous compound which admits of being reduced by the lead and reoxidised by the air giving the reaction of nitrite when reduced). The continuation of action observed to take place in a nearly neutral water, where oxyhydrate of lead is produced for weeks together, is due to nitrite acting as an oxygen carrier between the air and the lead. The rate of action is increased when copper, silver, and other metals are in contact with the lead beneath the water. The rate is diminished when zinc, tin, and other metals are similarly in contact with it, these metals suffering oxidation in preference to the lead.

DISCUSSION.

Dr. Rideal asked whether the reduction of nitrate to nitrite took place in the experiments cited by Dr. Garrett, only when a "couple" of two metals was employed; and if the reduction was continued to ammonia; as with a copper-zinc couple the presence of nitrite, and therefore of an oxygen carrier, would be prevented?

Mr. W. R. Maguire (Dublin) said that in Dublin the public water supply from the Vartry River is a very pure one, resembling the Glasgow water from Loch Katrine. Fifteen years ago it was discovered that lead pipes and cisterns were attacked by this water, and the Corporation, in order to prevent lead poisoning, ordered that all lead pipes for water should contain 3 per cent. of tin. This had been carried out for 15 years without any case of lead poisoning attracting attention. Sir Charles Cameron found that small carp placed in the lead tanks showed signs of paralysis which so cramped their bodies that it caused them to miss their food as they darted at it. In tanks made of lead alloyed with 3 per cent. of tin this did not occur. Mr. Maguire inquired whether this alloy would give absolute security against lead poisoning. Small iron pipes could not be used to convey Vartry water, as the pipes were choked within a few months.

Dr. Russell mentioned a case in which a very pure water had dissolved a large amount of zinc from the containing tank.

What is the Importance of Magnesia in Drinking Water?

BY

PERCY F. FRANKLAND, Ph. D., B. Sc. (Lond.), F.R.S., Professor of Chemistry in St. Andrews University, Dundee.

It must be confessed that in spite of the enormous amount of attention which has for years been devoted to the chemical analysis of drinking water, we are still lamentably ignorant of the precise hygienic importance of the mineral constituents which analysis reveals. Indeed the diversity of opinion regarding these mineral substances is far greater than concerning the more obscure and less easily handled organic matters of drinking-water. Thus some authorities actually prefer waters containing a very considerable proportion of mineral matters, others object to such waters, and others again regard the matter with complete indifference. Phosphatic calculi, goitre, and cretinism have been by some referred to waters containing lime and magnesia salts, whilst others have adduced evidence that such disorders are wholly unconnected with hard water. This question of the relative fitness of hard and soft water for drinking purposes was submitted to

investigation by the Rivers Pollution Commission of 1868, who, after devoting no less than 16 pages to a critical review of the evidence before them, leave the matter in the supremely unsatisfactory condition indicated by the following words:—

> "We are, therefore, of opinion that whilst waters of excessive hardness may be productive of calculous and perhaps other diseases, soft and hard waters, if equally free from deleterious organic substances, are equally wholesome."

The said Commissioners are, however, entirely silent on the subject of magnesia; indeed amongst the innumerable analyses of potable water which occur in their Sixth Report there is, I believe, only one in which the magnesia is recorded at all. This is in the case of the water supplied from a deep well in the magnesian limestone to Sunderland, which is said to contain 3·96 parts of magnesia (MgO) per 100,000.

Within recent years there has however, arisen in certain quarters in this country a belief that magnesia when present in more than a very limited quantity is objectionable, and I am acquainted with at least one case in which an otherwise unimpeachable water was discarded in consequence of its containing a few grains of magnesia per gallon.

This view is the more open to question in consequence of the very limited information which is available concerning the proportions of magnesia which are commonly met with in British potable waters. The determination of magnesia is one of the most laborious which occur in water examination, and is consequently but rarely undertaken by water analysts; from time to time, however, I have had occasion to determine the magnesia in waters which have been submitted to me, and I think that it may not be without interest to place on record some of the results which I have obtained more especially on this occasion, so that the proportions met with in British waters may be compared with those found on the Continent where the magnesian formations are much more largely represented.

In the accompanying table, pp. 84 and 85, I have recorded the results of analysis of a number of typical samples, which serve to illustrate the proportions of magnesia found in the supplies obtained from some of the more important water-bearing strata of great Britain.

These analytical results show that the calcareous waters derived from the chalk contain only a very small proportion of magnesia, and that even in the highly saline waters obtained from the chalk below the London Clay the amount is also very moderate, only distinctly greater than in the case of the normal chalk waters.

The proportion of magnesia, again, is considerably greater in the water from the lias, as represented by the wells at Wellingboro', whilst the largest proportions were found in waters from the magnesian limestone and new red sandstone.

[ANALYTICAL TABLE.]

RESULTS OF ANALYSIS EXPRESSED IN PARTS PER 100,000.

Description - (I.)	Total solid Matters.	Organic Carbon.	Organic Nitrogen.	Ammonia.	Nitrogen as Nitrates and Nitrites.	Total Combined Nitrogen.	Chlorine.	Hardness. Temporary.	Hardness. Permanent.	Hardness. Total.	Remarks.
Spring water from Newark-on-Trent, used for brewing purposes - (II.)	257·05	·046	·013	0	·465	·478	2·9	17·2	162·8	180·0	
	Fe_2O_3 and Al_2O_3		CaO	**MgO**	Na_2O	SO_3	N_2O_5	SiO_2	—	—	
	·14		82·89	**14·74**	4·68	131·51	1·79	·98	—	—	
Pontefract water supply from Magnesian limestone. (I.)	88·84	·035	·010	0	3·315	3·325	5·9	16·6	37·2	53·8	Total **MgO = 9·23.**
Well in bunter beds of new red sandstone at Sandiacre, Derbyshire. (I.)	45·04	·097	·037	·021	·094	·148	2·0	19·5	18·7	38·2	Total **MgO = 7·05.** Total CaO = 10·78.
Spring at Matlock Bath, Derbyshire. (I.)	47·84	·021	·002	0	·030	·032	4·1	18·8	15·3	34·1	Total **MgO = 4·08.** Total CaO = 11·37.
Bore-hole in alluvium near River Derwent, Matlock Bath. (I.)	24·44	·117	·048	·020	0	·064	·9	9·0	8·2	17·2	Total **MgO = 2·53.** Total CaO = 5·60.
Boring in new red sandstone at Gainsborough, Lincolnshire. (I.)	49·97	·028	·008	0	0	·008	2·0	16·8	18·6	35·4	
(II.)	·19		11·94	**5·97**	2·84	16·62	0	·94	—	—	
Waters from Malvern :											Total :—
No. 1. - - (I.)	27·48	·092	·024	0	·668	·692	1·9	11·6	9·6	21·2	**Magnesia = 4·09.**
No. 2. - - (I.)	8·52	·045	·016	0	·354	·370	1·2	0	4·3	4·3	Ditto = ·75.
No. 3. - - (I.)	12·56	·033	·014	0	·277	·291	1·5	2·9	5·0	7·9	Ditto = 16·4.

Description - (I.).	Total solid Mg	Organic Carb	Organic Nitr	Ammonia.	Nitrogen Nitrates a Nitrites.	Total Combi Nitrogen.	Chlorine.	Temporary.	Permanent.	Total.	Remarks.
Wells at Wellingboro' before softening - (I.)	58·20	·036	·017	·004	0	·020	2·2	30·3	16·2	46·5	
(II.)	Fe_2O_3 and Al_2O_3		CaO	**MgO**	Na_2O	SO_3	N_2O_3	SiO_2	—	—	
	·35		21·97	**4·05**	2·31	11·30	0	1·01	—	—	
Ditto after softening with lime - (I.)	26 30	·035	·014	·004	0	·017	2·2	1·1	14·9	16·0	
(II.)	·02		6·42	**2·16**	2·24	12·03	0	·63	—	—	
Well in chalk, Southampton, before softening - (I.)	31·69	·024	·012	·005	·365	·381	1·6	23·0	2·7	25·7	
(II.)	·14		14·53	**·25**	1·21	·39	1·41	1·02	—	—	
Ditto after softening with lime (I.)	14·07	·021	·013	·004	·381	·397	1·6	5·6	3·0	8·6	
(II.)	·11		4·42	**·28**	1·12	·45	1·47	·94	—	—	Total **MgO** = **·92.** Total CaO = 12·35.
New River Company's water, London, before softening. (I.)	32·08	·150	·018	0	·308	·326	2·1	19·1	3·6	22·7	
Ditto after softening with lime. (I.)	13·48	·103	·017	0	·329	·346	2·1	1·9	3·4	5·3	Total **MgO** = **·80.** Total CaO = 2·14. Alkalinity (calculated as Na_2O) = 8·69.
Well in chalk below London clay, London - (I.)	59·29	·036	·013	·010	0	·021	8·3	10·0	0	10·0	
(II.)	·20		3·20	**1·97**	24·85	11·41	0	1·25	—	—	
Well in chalk below London clay, Victoria Dock, London, before softening (I.)	58·76	·111	·017	·050	0	·058	16·7	19·8	8·0	27·8	
(II.)	·22		12·57	**2·82**	13·13	3·96	0	1·44	K_2O =	·93	
Ditto after softening with lime and caustic soda - (I.)	44·20	·084	·016	·060	0	·065	17·3	2·4	6·0	8·4	
(II.)	·14		5·96	**·57**	15·76	4·01	0	·69	K_2O =	1·06	
Deep well in new red sandstone at St. Helens - (I.)	56·40	·099	·029	·004	0	·032	3·6	29·4	11·8	41·2	
(II.)	·15		15·76	**6·31**	5·82	7·33	0	·97	K_2O =	·33	
Ditto after softening with lime - (I.)	—	—	—	—	—	—	—	—	—	15·7	
(II.)	—	—	4·25	**5·41**	—	—	—	—	—	—	

It will be further seen that in all cases in which the proportion of magnesia is at all considerable (say, upwards of four parts), the permanent hardness is high (10 parts per 100,000 or upwards), whilst in none of the cases quoted is the permanent hardness above 10 without the magnesia being above four parts; in fact, in waters with low permanent hardness there is little chance of finding much magnesia, and *vice versâ*. Applying this rule, it will be found that in all probability an immense number of waters in common use must contain from four to six parts of magnesia per 100,000, a proportion which by some authorities is regarded as objectionable. Thus, of 28 samples of deep-well water from the new red sandstone analysed by the Rivers Pollution Commission, no less than 16 or more than 50 per cent. contained upwards of 10 parts of permanent hardness. Again, of 15 spring waters from the new red sandstone, seven exhibited upwards of 10 parts of permanent hardness. On the other hand, of 66 deep-well waters from the chalk, only five or 7·5 per cent. had upwards of 10 parts of permanent hardness; and of 28 spring waters from the chalk there was not one in which the permanent hardness amounted to 10 parts per 100,000.

If this investigation be extended to shallow wells, it will be found that the number of probably magnesian waters becomes enormously greater. Thus, of 87 samples of shallow-well water from the new red sandstone, no less than 84, or 96·5 per cent. had their permanent hardness in excess, and generally largely in excess, of 10 parts per 100,000; and again, of 33 samples of shallow-well water from the chalk, 27 exceeded the 10 parts of permanent hardness. Thus, without at all forcing the rule as to the relationship between permanent hardness and magnesia, it is obvious that waters containing from four to six parts of magnesia must be of very common occurrence indeed, and that a very large portion of our population must be supplied with them. Until, therefore, a far more searching inquiry than hitherto has been made into the alleged effect of such waters upon health, it appears to me highly undesirable that any importance should be attributed to such proportions of magnesia in drinking water which are otherwise of unimpeachable purity.

In conclusion, I would call attention to the effect of Clark's process on magnesian waters, which is recorded in several cases in the table. As a general rule, the proportion of magnesia removed by the treatment with lime is small, much smaller than that of the lime removed, but it is particularly worthy of notice that in the case where caustic soda was used in conjunction with lime, as is now frequently done in the softening of water for industrial purposes, the proportion of magnesia removed was greater than that of the lime.

As the recorded determinations of magnesia in British waters are comparatively scarce, I have thought it desirable to append the pro portions of lime and magnesia in a series of 50 brewery-waters which I have examined from all parts of the country, although in only a few instances am I able to assign the precise source of the samples.

BREWERY WATERS.

PARTS PER 100,000.

	Lime combined as Carbonate.	Total Lime.	Total Magnesia.
No. 1	11·96	18·21	·31
„ 2	7·49	7·74	3·90
„ 3	14·37	17·21	·20
„ 4	1·04	10·69	9·99
„ 5	13·91	20·67	·81
„ 6	3·36	6·26	2·24
„ 7	12·31	15·16	4·36
„ 8	3·24	6·34	1·34
„ 9	12·89	15·44	·76
„ 10	0	25·94	9·01
„ 11	16·27	20·46	1·81
„ 12	12·81	16·47	1·87
„ 13 (from Chapel-en-le-Frith, Derbyshire.)	0	1·04	·57
„ 14 (from Brighton)	14·06	20·87	1·11
„ 15 (Chalk below London clay)	2·81	2·81	1·33
„ 16 (from Cosham, Hants)	17·41	23·46	2·84
„ 17 (from Brighton)	10·30	13·69	·41
„ 18 „ „	11·51	16·39	·61
„ 19 (from Wrexham)	16·99	21·14	2·77
„ 20	6·40	10·74	·89
„ 21	10·37	10·69	6·21
„ 22	5·54	5·54	1·74
„ 23	9·53	11·13	·54
„ 24	13·11	15·67	·19
„ 25	2·84	3·37	1·40
„ 26	14·91	19·94	5·01
„ 27	5·91	7·16	1·07
„ 28 (from Reading)	15·90	25·57	1·21
„ 29	7·11	14·57	5·50
„ 30	20·26	23·04	8·81
„ 31	8·16	8·16	2·57
„ 32	14·51	17·00	7·36
„ 33 (from Cardiff)	5·04	14·86	3·91
„ 34	19·34	28·89	2·14
„ 35 (from Louth)	11·60	13·36	1·16
„ 36 (from Taunton)	9·79	10·16	1·27
„ 37	9·91	9·94	4·14
„ 38	9·36	11·87	·56
„ 39	13·94	15·21	·39
„ 40	·34	3·73	1·61
„ 41	17·64	32·56	5·99
„ 42	7·16	51·66	27·10
„ 43	12·71	46·60	20·57
„ 44	10·74	19·10	·60
„ 45	10·74	12·29	1·19
„ 46 (from Hertford)	12·61	14·37	·76
„ 47	·29	4·96	2·59
„ 48	10·04	11·00	3·03
„ 49	3·29	3·39	3·30
„ 50 (Chalk below London clay)	—	2·61	1·46

Average Magnesia = 3·41 parts per 100,000.

DISCUSSION.

Sir C. Cameron stated that the Dublin pipe-water was soft, containing only two grains of mineral matter per gallon. He found that soft lead pipes were sensibly affected by the water, and that small fish placed in tanks became affected or paralyzed. The waters in a large part of Ireland were hard waters, and contained magnesium as carbonate sulphate, and chloride. In many cases he had found from 3 to 10 grains of magnesium salts per gallon. The rock locally called calp, a limestone with large admixtures of aluminium silicates, silica, oxide of iron and iron pyrites, generally contained magnesia, often in large quantities. The Dublin well-waters were very rich in magnesium salts. He was not aware of any injurious influences upon health produced by these waters.

Dr. S. Barwise (Blackburn) stated that tinned lead pipes were quite satisfactory for soft peaty waters. The Blackburn water was very similar to the Dublin water; it acted on lead; but, owing to the Blackburn authority carefully insisting upon all lead pipes being lined with tin, they had no cases of lead poisoning.

Dr. T. M. Drown (Boston, U.S.A.) gave an account of the Massachussetts State Board of Health's investigations into the natural waters of the State, and described the establishment of isochlors or lines of equal chlorine-contents of the waters throughout the State.

Sir C. Cameron stated that in the soft waters in Ireland there was a relevancy between the amount of chlorine and pollution, but in the hard waters there was no such relevancy. Waters containing only 0·002 parts of albuminoid ammonia and 0·001 part of saline ammonia per 100,000 parts contained from 5 to 30 parts of chlorine per gallon.

The Importance of Periodic Analysis of the Air Breathed in Towns and Cities.

BY

K. N. Bahadhurji, M.D., Bombay.

Good food, good water, and good air are the three necessary elements which conduce to and preserve the health of living units. All sound and healthy sanitation for the preservation of public health is based on principles which vouchsafe and safeguard the purity and wholesomeness of the supply of these three vital elements. In the words of Dr. Guy: "Public Hygiene has to do with persons of every "rank of both sexes and of every age. It takes cognizance of the places "and houses in which they live, of their occupation and modes of life, "of the food they eat, the water they drink, and the air they breathe." Man is able for himself to reject any article of food which is injurious to his health, yet in all large towns and cities it is regarded as a canon of sanitation to provide against unwholesome articles of food getting into the general food-supply; and to do this effectually sanitation has called in the aid of legislation, and rightly so. The provision of a pure

water-supply in towns and cities is everywhere acknowledged as a great sanitary duty, and, after a pure water-supply is provided, to maintain it in a state of purity is regarded as a sanitary obligation. It is rigorously insisted, and justly so, that no impurity shall be permitted to have access to such water, because the fouling of drinking water is often followed by fatal diseases. All the consideration which sanitation bestows on the water of towns and cities is no less required for the town and city air. It will not be disputed that of the three important elements for the preservation of health and life air is the most important one, and naturally so, considering the power for evil it possesses when in a state of impurity. The mortality produced by using noxious articles of food is trivial as compared with the deaths from diseases due to the drinking of impure water; and the mortality on the score of drinking impure water is considerably less—at least ten times less—than the mortality due to the breathing of impure air. The infant requires no water, but pure air, and more of it than the adult, inasmuch as respiration is most active in infantile life. Zymotic diseases, which destroy so much infantile life, are due in a considerable measure to impurities in the atmosphere.

If, then, the air we breathe, compared with the water we drink, has such a powerful influence, and that to such an extraordinary extent, for good or for evil, on the health and life of the population according as it is pure or impure, the preserving of the purity of the atmosphere, and the *preventing* its fouling, even with the help of legislation, has certainly the strongest claims on the sanitary duties and obligations of civilized towns and cities. And we should, therefore, expect to find in all well-supervised towns that the condition of the air was as closely and constantly watched as the condition of the water. Instead of this, what do we find? Carefully prepared periodic chemical examinations of the water-supply are made, and the results are made public. The people know the quality of the water provided for them. From time to time the health officer on the strength of his analyses recommends special measures for purifying the water before use. But there is no such periodic examination made of the atmosphere, and not one person in 10,000 knows anything of the condition of the air he breathes. The municipalities provide, at considerable expense, a water-supply of as pure a quality as can be obtained, and they take measures to maintain its purity. A pure air-supply is a provision of nature, and nature does try to maintain its purity. As soon, however, as population increases and a large number of dwellings are put up within limited areas, as occurs in towns and cities, the atmosphere necessarily gets vitiated to a certain extent; and the conditions of town and city life are inseparable from a somewhat polluted atmosphere. The expired air of human beings and animals is one constant source of pollution of nature's pure air. The dry sewage or garbage of cities, which is always accumulating as fast as it is carted away, is another source of pollution, and the decomposition of liquid sewage, whether in drains, sewers, or cesspits, is a third source of pollution. All these sources of pollution of town and

city air are ever active, and more so by night than by day, more active in warm than in cold climates. The oxygenation in plant life and the perpetual motion of the atmosphere itself are the powerful means nature has at her command for preserving the purity of its air supply.

But are they enough to cope with the constant sources of pollution in towns and cities? Does not experience teach us that the efforts of man to vitiate the atmosphere are always, and especially in such places as towns and cities, able to overcome the efforts of nature to keep up the purity of her air-supply? It is an everyday experience that wherever large numbers of people are crowded together, in theatres, public halls, workshops, mills, and other similar places, and where the ventilation of the buildings is defective, the proportion of impure constituents increases, and the atmosphere becomes distinctly vitiated and unsuited to the preservation of health. This is the way in which the atmosphere of towns and cities is poisoned, and the tenants of these houses made ill. The deadly effects of atmospheric blood-poisoning were most unmistakably seen in the unfortunate victims of the Black Hole of Calcutta, and in the prisoners after the battle of Austerlitz. And the experiments of the late Dr. Angus Smith have familiarised sanitary officers with the effects of vitiated air in human dwellings and in public halls.

But experience has abundantly shown that the general atmosphere of towns and cities as observed in the streets, in open places, and in gardens is always in a more or less impure state. And indeed, certain towns and cities have such characteristic smelling atmospheres that their names could be pronounced by the sense of smell alone. The odours of Bombay are peculiar to itself, and travellers smell Bombay a long way off. But the inhabitants themselves get so used to their own town odours that they, in time, do not perceive them. The natives, although they daily indulge in ablutions before every meal to keep their persons clean—and cleanliness is health—little think of the pollution of the air they breathe, often a fatal pollution to which they undoubtedly contribute through indifference, or ignorance, or both. The degree of impurity in the air which is inseparable from the conditions of town and city life is easily exceeded, and whenever impurities in the atmosphere exceed ordinary limits rapidly and to an unusually high degree, their poisonous effects at once manifest themselves. Fevers and throat affections and cases of blood-poisoning multiply in the city, especially in the hot months, when the sewers are most active in polluting the house and town atmosphere; then it is, also, that zymotic diseases increase vastly and provoke a great mortality, all of which might be prevented if the atmospheric conditions of the towns were regularly investigated, for means might be taken before the impurities have gained access to the atmosphere to such a dangerous extent. These rapidly occurring and often fatal effects of the fouling of the town and city air, no doubt, arrest attention, for they cause sudden and striking rises in the mortality. But there is a more insidious and slow process of poisoning which the population at large undergoes, and the

extent of its deadly influence is far in excess of that of the rapid process. A plentiful supply of fresh and wholesome air is the chief food of the blood. A falling off in its food-supply either in quality or quantity, or in both, is necessarily followed by poverty of blood which ends in general deterioration of physique. Not only does the blood suffer thus, but so also do the lungs, through which the air has access to the blood. When a healthy plant from the open garden is removed to a dark and dingy place with a foul atmosphere, the freshness and colour of its leaves—the lungs by which the plant breathes—decline, and signs of fading life gradually appear which ultimately overtake the whole plant itself. Is it to be wondered at that in the reaction between human lungs and the atmosphere impure air exercises similar deleterious effects? Tuberculosis derives its chief power from foul air. But short of true tubercular disease, there is a low form of lung breaking-down, a mild form of chronic phthisis which one meets with extensively in practice. Evidences of this form of lung mischief are to be found in patients who are admitted into the hospitals for other complaints. They are to be very generally noticed amongst people who have no idea of ventilation or of the wholesomeness or otherwise of the air they breathe, such as the occupants of chawl-rooms (which may have no windows, or, if there be any, they are generally shut); amongst people whose dwellings are apparently like mansions, but who occupy rooms therein to which one cannot see his way without candle-light even at mid-day; and in the occupants of lofty dwellings which have their atmosphere constantly fouled by the emanations from the godowns and animal-sheds below, and by the foul gas escaping from the decomposing garbage in the gullies, or by the sewer gas which keeps up a constant current through holes and escapes in the sullage pipes specially provided for it by the genius of the plumber. Indeed, the plumber has more to answer for in endangering public health and life than the jerry builder who jeopardises the lives of a few individuals by his fragile structures. The incompetent plumber is certainly the arch offender. He undermines general public health, and that in an insidious and unwary manner. It is a matter of congratulation that a special meeting of the Congress has resolved to urge upon the authorities the necessity of registration of plumbers, thereby eliminating the most serious, and yet the most preventible, element of danger to public health, by legally exacting from them a standard of education and training which would naturally carry with it a knowledge of the responsibility of their vocation and of their duty to the public at large. These little details have been gone into only to show the extent and gravity of the danger to public health from the undue fouling of town and city air, and all from preventible causes. Great and grave as the mischief is that is wrought by this fouling of Nature's pure air, the remedy is most simple and by no means difficult to apply, and to apply successfully. But to apply the remedy successfully, the right character and source of pollution must be traced; and neither the character nor the source of pollution can be traced unless systematic tests are applied regularly. And this cannot be done unless systematic air analyses are regularly and periodically made.

It will now be apparent that a regular examination of the air in towns and cities is as necessary, for the purposes of preserving public health, as the examination of the water-supply; and, indeed, more necessary. It is strange that no regular system of examination of the air of towns and cities has as yet found a place in sanitary police. Air analysis is undertaken in individual cases here and there for certain purposes. But the object of this paper is to point out that the work should be undertaken systematically in all towns and cities; and that the examination should include the air condition, not only of public halls, workshops, and kindred places, but of private dwellings, gulleys between houses, lanes, streets, parks, playgrounds, and places of all kinds temporarily or permanently occupied by human beings and animals. Much sanitary advantage would result if air analysis as now discussed were given its regular place in the reports of the health officer. It may be mentioned that, by resorting to air analysis, the atmospheric conditions of the public hospitals of Great Britain have been permanently improved. Exactly the same amount of improvement could be effected in towns and cities by applying similar tests to the whole of the populated areas. Fortunately, it happens that the sanitary duty now insisted on may be carried out without involving any but a small financial expenditure, while the chemical qualifications required to do the work are by no means great. In Indian towns and cities the subject of air analysis is almost unknown. In Bombay the health officer is the water analyst, but an air analyst has no existence. It is in India that this system would prove a very decided blessing, and for two special reasons, (1) because it is there that organic and vegetable pollution largely prevails, and decomposition of impurities takes place with great rapidity in the face of a high temperature, (2) because liquid sewage is a dangerous difficulty in that country, much more dangerous than in England.

DISCUSSION.

Professor Odling stated that the analysis of air for sanitary purposes was not new, and pointed out its value in regard to the incidence of disease. He considered that such an investigation as that proposed by the author to be carried out in India would be most important.

Sir C. Cameron said that the biological examination of air was of even more importance than the chemical. As a member of the Army Sanitary Committee, and a Special Commissioner from the War Office, he investigated the causes of the excessive amount of typhus fever in the Royal Barracks, Dublin. He found that the number of micro-organisms falling per minute per square foot in a well-known unhealthy part of the barracks greatly exceeded the number falling in healthy parts. As to the frequency of pulmonary disease in Bombay, where there was a high temperature and constancy of temperature, he believed that changes of temperature or exposure to cold produced bronchitis, post-nasal catarrh, &c., but did not affect the lungs; these, however, became the seat of

disease when tainted air was inspired. The prevalence of pulmonary disease in Bombay appeared to be due to blood poisoning.

Dr. Gibbon insisted on the importance of the systematic chemical and bacteriological examination of air in all cities and towns.

Dr. Nasmyth had investigated the air of mines, and his experience was that the air of coal mines was much purer than the air of an ordinary inhabited house. He pointed out that the organic impurity of any given atmosphere could not be measured by the number of organisms that it contained, the number of these organisms depending upon other conditions. Near habitations the number of micro-organisms increased largely in the air. He regarded it as very important that the air of mines should be subjected to systematic examination.

On the Effects of the Respiration of Carbonic Acid on Man.

BY

W. MARCET, M.D., F.R.S.

The subject is dealt with under three headings:—

Firstly. The source of the presence and accumulation of carbonic acid in the air breathed.

Secondly. The action of re-breathed air on the human body.

Thirdly. The action of carbonic acid gas breathed in volumes which either produce insensibility or prove fatal.

Firstly. The source of the presence and accumulation of carbonic acid in the air breathed.

This is derived principally from the decomposition of organic matter in the earth, and also in some measure from the consumption of coal. The amount of coal consumed in London and 15 miles around is about 9,400,000 tons per annum, which would give out 28,866,867 tons of carbonic acid, equal to 3·53 cubic miles of that gas. A source of carbonic acid, perhaps least thought of, is derived from the process of fermentation, as in the manufacture of beer; this gas is usually lost, but it is now, in some instances, collected from the vats, condensed into the liquid form, and used mostly for refrigerating purposes. The amount obtained from Messrs. Guinness and Co. is said to reach the enormous figure of 32 tons per diem. Again, the inhabitants of large towns must contaminate the air with their breath. The occurrence of any great excess of carbonic acid in the atmosphere is prevented, however, by the extreme diffusibility of this gas, so much so, that under a comparatively clear sky in the streets of a large town like London, there are barely more than four parts in 10,000 of air, while in the country the proportion may be considered to be between 3·5 and 3·8 parts.

I have made experiments relating to this subject in conjunction with my friend Mr. Landriset, D.Sc., of Geneva. They have been

recorded in the "Archives des Sc. Nat. of Geneva," and subsequently in the "Journal of the Meteorological Society for 1887." Our object was to find out if the proportion of atmospheric carbonic acid varied between such different levels as the town of Geneva and the highest point of the Jura Mountains, called the Dole, the difference in altitude being 4,193 feet. Former experiments on this subject by Th. de Saussure and P. Trochut had given different results; de Saussure found an increase of CO_2 in higher altitudes and Trochut a decrease. Our experiments were undertaken simultaneously at both stations, and the state of the weather was carefully recorded at the time, a precaution the other observers do not appear to have taken. Fifty analyses were made altogether, by Pettenkofer's method, at both stations inclusively, and the results show distinctly that in fine, clear weather, there was no difference between the proportions of CO_2 in the air of the two stations; therefore, under a cloudless sky, the carbonic acid diffuses equally throughout the atmosphere. Three experiments made on the mountain while the observer was in a fog or cloud, the corresponding experiments near Geneva being carried out in fine weather, gave 3·24 parts of CO_2 for the high station, and 3·88 for the low station and in clear weather; on another occasion, one experiment on the mountain while in the clouds gave 2·94 of CO_2, while three-quarters of an hour afterwards, the fog having temporarily disappeared, the sun came out brightly and the CO_2 rose to 3·91 parts, falling again when the cloud formed afresh round the observer. It follows, therefore, that on the top of a mountain there is less CO_2 in a cloud or fog than in fine clear weather.

From Dr. Russell's experiments, and those I have also made on the same subject, there can be no doubt that the very reverse takes place in large towns in foggy weather; when the streets of London are obscured by a dense autumnal fog the atmospheric CO_2 is greatly increased. This is clearly due to the carbonic acid generated in towns being absorbed by fogs, while the diffusion of the gas is much less rapid through fog than through the atmosphere when clear. But on the top of a mountain the CO_2 formed on the spot is small, and when, after diffusing through a cloud, it reaches the outside, the tension of the gas is rapidly increased by the sun's action, and it escapes. This same tension will prevent the cloud from absorbing CO_2 from below, and so the cloud loses its atmospheric CO_2.

Secondly. The action of re-breathed air on the human body.

According to E. A. Parkes, the effect of fœtid air containing organic matter produced by respiration is very marked on many people, causing heaviness, headache, and in some cases nausea. It is stated, in this author's "Manual of Practical Hygiene," p. 115, that from experiments on animals, Gavarret and Hammond have found that the organic matter of the breath is highly poisonous. Besides CO_2, we have certain volatile constituents of food, such as alcohol, garlic, &c., which are found in expired air after being swallowed. Like all other substances ejected from the body, such gaseous products must be unfit for use, and injurious in a concentrated form, but it is also very possible that

some nitrogenised organic matter, not present in food in a volatile form, is given out from the lungs. Expired air invariably discolours potassium permanganate, gives rise to the formation of sulphurous acid when passed through sulphuric acid after filtering through cotton wool, and can be made to yield ammonia. As to the unhealthy action of ill-ventilated dwellings, an interesting paper in the "Phil. Trans." for 1887, by Messrs. Carnelley, Haldane, and Anderson, shows that there is a great increase in the mortality of children, especially under five, who inhabit one-roomed houses over those in four-roomed houses, and that this is owing to the accumulation in the air of carbonic acid, micro-organisms, and other atmospheric impurities.

I have lately carried out experiments on re-breathing air, which are described in the "Proceedings of the Royal Society" for the present year. The experiments were made on four different persons in a state of repose, the mode of breathing being perfectly natural. They began by expiring the air they breathed into counterpoised bell-jars suspended over salt water, and the CO_2 this air contained was determined; the next, or second stage, of the experiment was to re-breathe 35 litres of air from and into a counterpoised bell-jar during five minutes (inspiring through the nose and expiring through the mouth); immediately after emitting the last expiration of re-breathed air, and while taking an inspiration of fresh air, the air expired was turned into another jar by means of a three-way cock. After the third quantity of air had been collected, the air expired was directed into the first jar (now emptied) and the fourth and final quantity was taken. The carbonic acid in every case was determined by Pettenkofer's method.

The results from this inquiry were as follows:—

(1.) On re-breathing air in a closed vessel less carbonic acid is expired in a given time than in ordinary breathing.

(2.) The persons who emit most carbonic acid in re-breathed air are those who expire most carbonic acid and air in the same time in ordinary breathing.

(3.) On re-breathing 35 litres of air in a closed vessel for a period of five minutes, the volume of this air undergoes a slight reduction.

(4.) When fresh air is taken into the lungs, immediately after re-breathing air in a closed vessel, the volumes of air re-breathed and weights of CO_2 expired are greater than in ordinary breathing.

(5.) The effects produced on the chemical phenomena of respiration by re-breathing 35 litres of air in a closed vessel during five minutes have passed away in less than six minutes after the breathing of fresh air has been resumed.

In an experiment, made before the Physiological Society, the gentleman who assisted me at that time re-breathed for nine minutes the small volume of 10 litres of air; a recording instrument being connected with the bell-jar showed distinctly the increase in the amplitude of the

respirations and in the speed of the respiratory movements as the air became more and more vitiated.

My inquiry yields one result, which appears to me important in point of view of hygiene—that the effects produced by re-breathing air, I mean the increased volume of air breathed in a given time and CO_2 expired, pass off very rapidly after breathing pure air. Hence, the importance for people who are called upon to make a prolonged stay in ill-ventilated apartments to go out into the open air as often as possible, were it only for a few moments at a time, and to sleep in well ventilated rooms.

Thirdly. The action of carbonic acid gas breathed in volumes which either produce insensibility or prove fatal.

The effects produced by the respiration of air mixed with carbonic acid vary considerably according to the rapidity of the action. The influence due to the suddenness of the exposure, is well illustrated by an experiment of Claude Bernard. A sparrow was placed under a glass receiver of two litres' capacity; after two hours, it was still alive, two other birds were then introduced into the receiver and they died; the first sparrow was withdrawn an hour later, warmed and when quite well, was again introduced, when it died immediately. This experiment is very interesting in point of view of hygiene, showing that people who become gradually accustomed to a close atmosphere can exist in comparative comfort under conditions which might prove baneful, and perhaps fatal, to others used to a life in the open air.

Claude Bernard also found that carbonic acid is innocuous when injected into the veins and arteries of a dog, the gas being exhaled at the lungs; on the other hand, birds died in air containing in 100 parts:—

Oxygen - - - -	39
Carbonic acid - -	13
Nitrogen - - - -	48
	100

showing that when breathed, even in the presence of an excess of oxygen, the action of CO_2 is no longer the same as when injected; the injected gas is being continuously given out at the lungs, the inspired gas undergoes continuous accumulation until its proportion is too great for the maintenance of life.

I have made experiments upon myself and others, when about 35 litres of air containing from 2·5 to 4 per cent. of pure CO_2 was inspired from a bell-jar and expired into the external air. The CO_2 accumulating in the body, the effects became more marked as time elapsed; the first minute a slight want of air was experienced, but in the fourth or fifth minute, the sensation was decidedly uncomfortable, and could not have been endured much longer.

Dr. Angus Smith made investigations (published in 1872, in his book on "Air and Rain") in which an air-tight chamber containing 3·84 per cent of CO_2 was entered by two gentlemen, who got headaches

instantaneously and were unable to stay above seven or eight minutes. Dr. Smith remained in the chamber for 20 minutes, and then felt very uncomfortable, and anxious to get out. An interesting inquiry by Dr. Emmerich was made at Munich in 1887 or 1888, and published with an addendum by Dr. von Pettenkofer. Several observers, including Dr. von Pettenkofer, having entered a vault in the Institute of Hygiene at Munich in which several candles were burning, CO_2 was evolved by opening two cylinders containing the compound in the liquid form; in about a quarter of an hour two of the candles went out and several persons left the vault, only Dr. von Pettenkofer, Herr Trillich, and Herr Rats remaining, the two latter gentlemen staying until all the CO_2 in the cylinders had evaporated. The candles went out when the air contained eight per cent. of CO_2. According to other experiments by Karl Friedlander and Edwin Herter, rabbits can live over an hour in an atmosphere containing 34 per cent. of CO_2.

There are many records of accidents from the inhalation of carbonic acid gas: one of the most remarkable I ever came across is recorded in a Geneva newspaper, the "Journal de Genève," of the 7th October 1886. The account is very short, and I venture to give a verbatim translation of it. "A melancholy accident has just "thrown into a state of utter consternation the small village of "Constet, near Barsac, 30 kilometres from Bordeaux. Two labourers, "named Loubrié and Blanc, were working in a cellar belonging to "Mr. Gaussem, a merchant. Blanc observed that wine was fermenting "in a vat; he went into it with the object of pushing down the grapes, "which the evolution of gas in the fluid had driven to the surface. He "instantly fell asphyxiated. Loubrié called for help, and a man named "Finore, who was working in the neighbourhood, ran up and went "into the vat to try and save Blanc. As he did not re-appear, Loubrié "tried to rescue both men but he also perished in a like manner.

"Two courageous persons, Chassin and Puzos, went down one "after the other into the vat, notwithstanding the protests and suppli-"cations of the witnesses of this horrible drama; both of these men "met with the same fate as the others. In order to remove the dead "bodies a portion of the roof over the vat had to be demolished. "Finore alone was still breathing and there are some hopes of his "recovery."

The foregoing remarks show:—

1st. That when air containing an excess of CO_2 is breathed, the gas accumulates rapidly in the blood, and under such a condition the phenomena of nutrition are more or less interfered with; and also that people working in ill-ventilated rooms and buildings, should, for the preservation of their health, sleep in as pure an atmosphere as possible, where they will rid their blood of the carbonic acid absorbed in the day time.

2nd. That the effects produced by the inhalation of carbonic acid gas depend greatly on the rapidity of the exposure. The sudden inhalation of air containing a large proportion of

the gas may produce rapid insensibility and death; while this same air might have been breathed for some time with a certain degree of impunity, had the carbonic acid present been introduced gradually.

3rd. That when life is threatened by the inhalation of carbonic acid, there is no reason to despair of artificial respiration so long as the heart is beating; the gas will diffuse rapidly from the blood into the air with which the lungs are inflated, and will thus, be carried out of the body.

DISCUSSION.

Sir Chas. Cameron drew attention to the experiments of Dr. Hammond in the United States, 10 or 12 years ago, showing that the harmful nature of expired air was due, not to the carbonic acid, but to the organic impurities it likewise contained, and that the ill effects continued after the removal of the carbonic acid by chemical means. This is also shown by the health of those employed in mineral water manufactories.

Professor Odling pointed out that the effect of the inhalation of pure carbonic acid gas was very similar to that produced by nitrous oxide.

Friday, 14th August, 1891.

THE PRESIDENT, SIR H. ROSCOE, IN THE CHAIR.

Meteorology in relation to Hygiene.

BY

ALEXANDER BUCHAN, M.A., LL.D., F.R.S.E.

No city can be compared with London as affording the best available materials for an inquiry into the relation of weather and health: the data for the inquiry being supplied (1) from an enormous population spread over an area so restricted that it may be regarded as having one uniform climate during each of the seasons of the year; (2) by fairly satisfactorily full reports, week by week, of weather and of the number of deaths from the different diseases; and (3) by returns extending over a sufficiently long time, viz., 46 years.

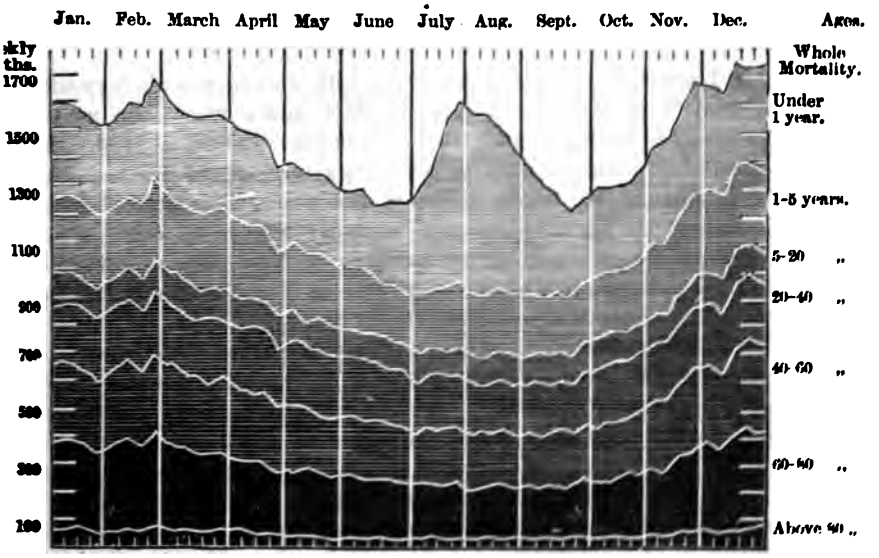
As regards such diseases as diarrhœa, bronchitis, and heart disease (Figs. 3, 2, and 6), which are to a large extent directly and immediately under the influence of temperature and humidity; and such epidemics as scarlet fever, diphtheria, and whooping cough (Figs. 4, 5, and 10), the rate of mortality from which is very largely determined by season and weather; a comparatively small number of years is required to give a satisfactory approximation of their true weekly curves or mortality. But in dealing with the data of a large number of diseases whose mortality is relatively small, it soon becomes apparent that all the 46 years are needed in order to give sufficiently close constants for the curves of weekly mortality for a considerable number of these diseases. The curves of weekly mortality thus arrived at suggest complications of special diseases and their connexion with each other, which complications would be entirely masked if monthly averages alone were employed.

The climate of London in its relations to the public health may be divided into six different types according to the season of the year, viz.:—1. *Damp and cold*, fourth week of October to third week of December; 2. *Cold*, fourth week of December to third week of February; 3. *Dry and cold*, fourth week of February to second week of April; 4. *Dry and warm*, third week of April to third week of June; 5. *Heat*, fourth week of June to 1st week of September; 6. *Damp and warm*, second week of September to third week of October.

The curve for the whole mortality (Fig. 1) shows two maxima of very different degrees of intensity; one the greatest and longest-continued

Fig. 1.

Mortality at different Ages—for both Sexes and all Causes.

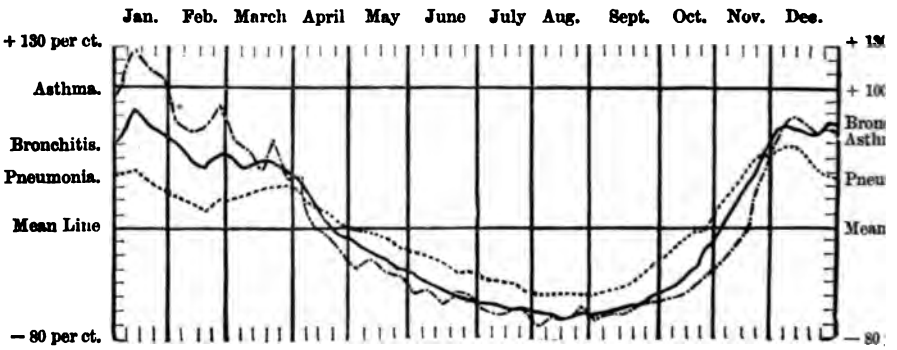


extending from November to April, and the other strictly confined to the summer months. Now the singular point of the summer maximum is that it virtually disappears if the mortality among infants under one year be subtracted from the whole mortality. Hence the most deleterious element in the climate of London to the health of the people is the low temperature of the winter months; and this remark may be extended *to all* climates in which the temperature of the winter months falls repeatedly below 40°.

Of the diseases by which the excessive winter mortality of London is occasioned, the first place must be assigned to diseases of the respiratory organs (Fig. 2), notably bronchitis and pneumonia, to which alone one-fifth of the whole mortality of London is attributable. Statistics show that the greatest fatality from these diseases occurs when the temperature is between 32° and 40°; or, say, between the temperature of the maximum density point of water and its freezing point. Thus, in New York, where the mean temperature of winter is 10° lower than

Fig. 2.

Bronchitis, Pneumonia, and Asthma—for all Ages and both Sexes.



that of London, the mortality from bronchitis and pneumonia is greatly less; and it is also greatly less in Melbourne, where the winter temperature is 10° higher than that of London. Indeed, in Melbourne the death-rate from diseases of the respiratory organs forms but a small fraction of the whole deaths of the year. This general result is confirmed by the climatic and mortality returns of other cities. Similarly, the higher summer temperature of New York as compared with London results in a higher death-rate in New York in spring and early summer from brain diseases (Figs. 7 and 8).

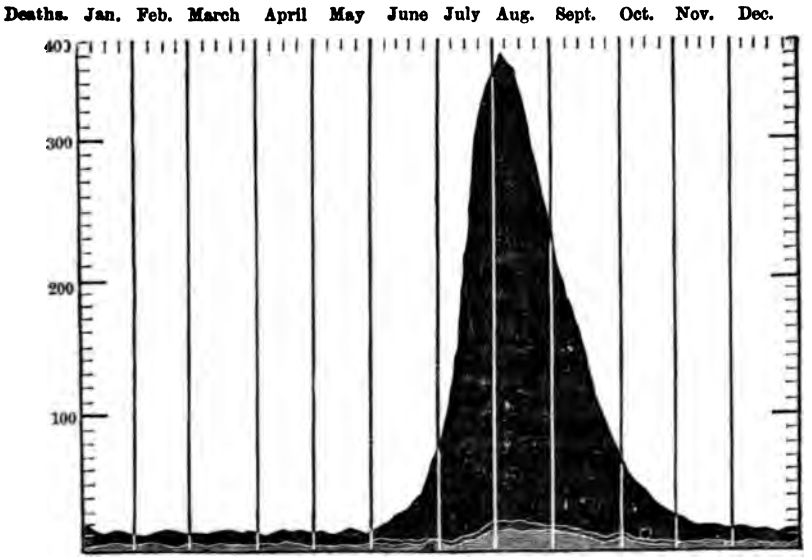
There is, however, an element of weather other than mere temperature which plays an important part in bringing about a high death-rate. That element is fog, which in proportion to its density and persistency sends up the mortality with alarming suddenness to a degree exceeded only by Asiatic cholera. Let me emphasize the fact in the strongest manner that it is not low temperature by itself, but low temperature along with dense and persistent fogs which is accompanied with this appalling mortality. A single illustration will make this clear.

Last winter was, as regards London, one of the very coldest on record. With the low temperature the deaths from bronchitis rose greatly above the average of the season, the highest in any single week being 711 during the second week of the year. But during the low temperature and dense fogs of the winter of 1880 the mortality from bronchitis rose to 1,223 during the first week of February.

In summer, when '*heat*' is the chief characteristic of the climate, the maximum at that season is caused by diseases of the abdominal organs (Fig. 3). The peculiarly malignant character of summer diarrhœa

Fig. 3.

Diarrhœa.



NOTE.—The darkest shaded part indicates deaths under 5 years, the lighter portion at foot of figure shows the deaths at successively higher ages.

among young children under five years of age is seen by the mean weekly mortality rising from 20 in the middle of June to 342 in the first week of August—when the temperature is about the average of the season. But in July 1876, when the temperature was 3°·6 above the average, the mortality from diarrhœa among children rose to 502 on the last week of that month. On the other hand, during the cold summer of 1860 the largest number for any week did not exceed 90.

Of the large British towns, the lowest mortality from summer diarrhœa is that of Aberdeen, which has at the same time the lowest summer temperature. The diarrhœa mortality of each large town rises from year to year proportionately with the increase of temperature; but the rate of increase differs widely in different towns, pointing to causes other than mere weather, these causes having their origin in the sanitary condition of the town. The recognition of this in quite recent

years, and the measures taken to remedy matters, are among the most satisfactory outcomes of the inquiries we have now in hand.

The curves suggest several contrasts and other relations *inter se.* Thus, while the whole mortality shows September and October to be two of the healthiest months of the year, the curves for scarlet fever (Fig. 4), typhoid, and diphtheria (Fig. 5) form striking exceptions. These three curves are closely related to each other, each having, however, a well-marked individuality of its own. It is a singular circumstance that diphtheria shows closer relation in the phases of its death-rate with typhoid than with scarlet fever. The curve for mortification is substantially that of nervous diseases, and the curves for erysipelas and puerperal fever are in all essential respects the same. The curve for old age runs exactly parallel with the curve for paralysis. The curves for skin diseases, rheumatism, dropsy, pericarditis, Bright's disease, and kidney disease exhibit the closest and most striking alliances with each other.

Fig. 4.

Scarlet Fever—for all Ages and both Sexes.

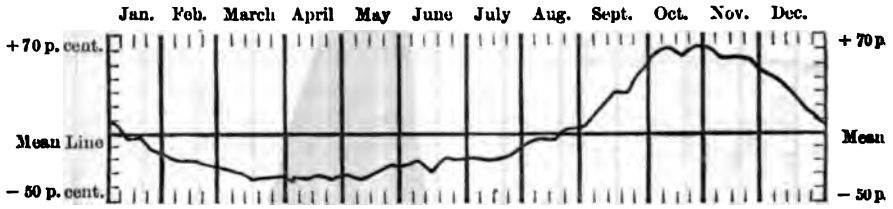
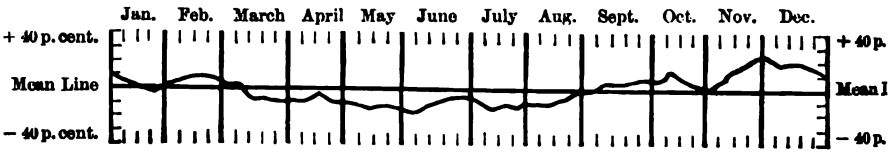


Fig. 5.

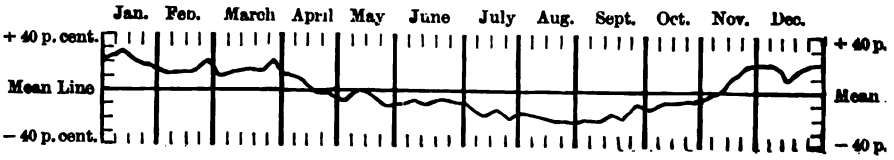
Diphtheria—for all Ages and both Sexes.



Lastly, while diseases of the abdominal organs attain their greatest mortality when temperature is highest, diseases of the respiratory organs and of the circulatory system (Fig. 6) when temperature is lowest,

Fig. 6.

Circulatory System—for all Ages and both Sexes.



nervous diseases (Figs. 7 and 8), phthisis (Fig. 9), and whooping-

Fig. 7 (New York).

Meningitis and Encephalitis—for all Ages and both Sexes.

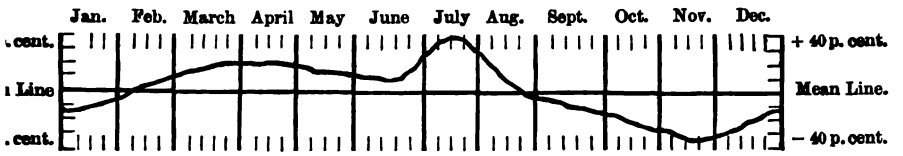
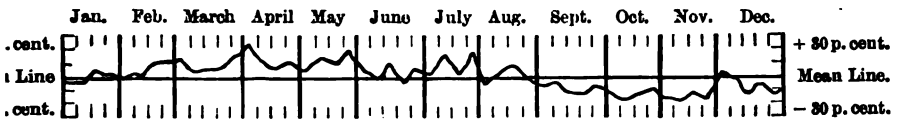


Fig. 8 (London).

Cephalitis.



cough (Fig. 10) in the dry weather of spring and early summer, and skin diseases and certain fevers during the raw weather of autumn and early winter, the diseases which are quite removed from weather influences (such as peritonitis) exhibit curves which show no obedience to season, but merely a succession of sharp irregular serratures.

Fig. 9.

Phthisis—for all Ages and both Sexes.

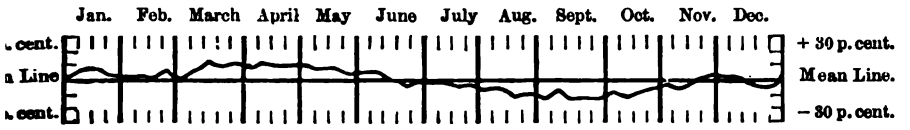
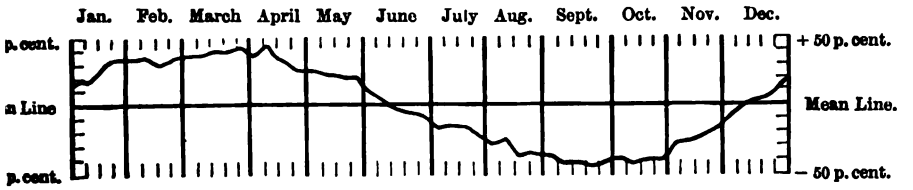


Fig. 10.

Whooping Cough—for all Ages and both Sexes.

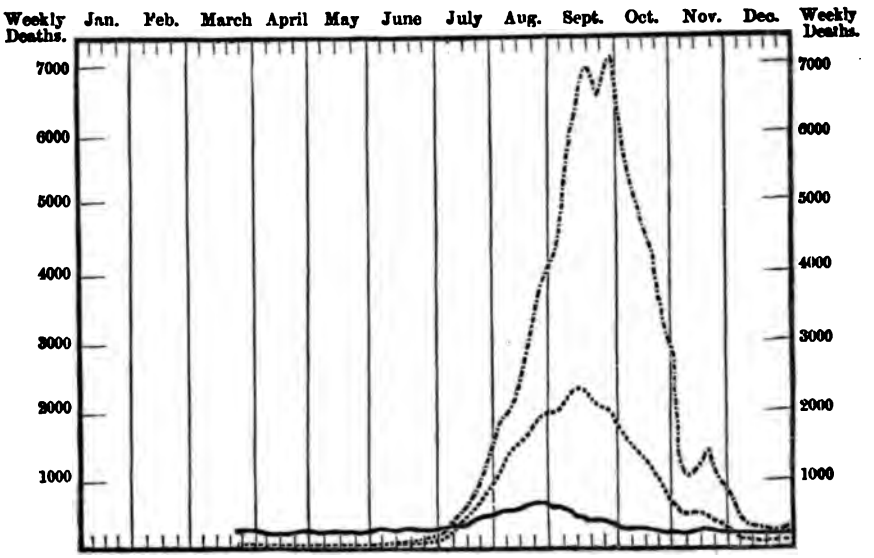


The weekly returns of the last six plagues of London (Fig. 11), published in 1662 by John Graunt under the auspices of the Royal Society, have been examined in view of the results now established. The manner in which

the Plague, as a death-producer, obeyed the weather, is striking. It did so exactly as we now see bowel complaints to be influenced by weather.

Fig. 11.

SHOWING BY THREE CURVES—(1) Doubly-dotted Line or Highest Curve, Weekly Mortality during the Great Plague in 1665; (2) Lower Dotted Curve, Mean Weekly Mortality of the Six Plagues; and (3) Solid-lined Curve, Mean Weekly Mortality from all other Diseases during continuance of the Six Plagues.



The curve for the Plague bears no resemblance whatever to the curve for typhus, or indeed to that of any disease except bowel complaints. This close resemblance suggests whether there was not a closer alliance between them than has been suspected. If the results now ascertained be regarded as a fair outcome of our inquiries into the relations of weather and health, it is plain that such investigations may point to a set of morbid processes which have been cloaked by prominent phenomena, apparently of a primary, but in reality of a secondary character.

DISCUSSION.

Dr. G. B. Longstaff stated that meteorological curves and curves of deaths, however closely related on cause and effect, could not possibly correspond exactly, owing to the fact that the interval between the death and its registration averaged about five days, and the interval between the commencement of an illness and a resultant death was of uncertain and often considerable duration. He stated that, in his opinion, meteorological changes were not of themselves the cause of death, though the number of deaths appeared to be a function of those changes. Fog alone, or cold alone, did not directly cause the deaths from respiratory diseases; but there was a *tertium quid*, perhaps the germ of ordinary communicable catarrh. Fogs must be distinguished into

those mixed with smoke and those free from smoke, the latter probably not having any pathological significance. Again, smoke fogs must be divided into those in contact with the ground and those forming a pall overhead, probably the latter would be found to have comparatively small influence upon the mortality. He explained the very close relation between the curves of apoplexy and mortification by the fact that both are symptoms of disease of the arteries chiefly in old people; that cold raised the blood pressure and hampered the circulation, resulting in some cases in rupture of an artery and apoplexy, in other cases in stopping of the local circulation and mortification. In conclusion, he stated that Messrs. Buchan and Mitchell deserved great credit for their valuable improvements in the methods of exhibiting statistical results.

Dr. Tripe, Medical Officer of Health, Hackney, said that Dr. Longstaff had already referred to the interval which elapsed between the death and registration, and also to that between the weather causing the illness and the deaths. He had in his investigations allowed two weeks, but he now thought that to be too small an interval except as regards diarrhœa and perhaps diphtheria. In the former, the action of heat is rapid so soon as the temperature of the soil at a depth of six inches, or of the Thames, reaches 65°. As to the effect of fogs, they vary very much according to their density and quality. This was well shown by the fogs during January and February 1880, when they were so dense as to prevent him from seeing the kerb, and the number of deaths from inflammatory diseases of the lungs was then more than double those in 1891, when the temperature was lower than in 1880.

Mr. W. North called attention to the curves drawn by Professor Tacchini, showing the relation between the rainfall in the months of March, April, and May, and the number of cases of fever in the Province of Rome in the autumn. As the result of his own experience in the Roman Campagna, the author was led to entertain grave doubts as to the possibility of explaining the phenomena of intermittent fever on the hypothesis of a pathogenic organism; the relation of malaria to local climatic conditions is no longer a matter of question, and is so close that it appears to be not unreasonable to regard the latter as powerful factors in causing, if they are not themselves the cause of, the disease. It appears that the mode of operation of these climatic changes on the organism may be accounted for on some such hypothesis as the following: the temperature of the body may be reasonably regarded as the result of the interaction of two rhythmically acting forces, interference with one or other of which will produce the phenomena of beats, to which the regular intermission of malarial fevers have at least a very close resemblance.

Dr. Russell pointed out, with regard to London fogs, that when there was a great increase of death-rate a low temperature always accompanied the fog, but that there were, on the other hand, several cases of dense fogs without decrease of temperature, and then the death-rate did not fall below the average; hence it appeared unfair to say that the fog itself was the sole cause of the great mortality.

In reply to Dr. Russell, **Dr. Buchan** stated that he fully agreed that it was impossible to determine how far the increased mortality in cold foggy weather was due to the fog, and how much to the low temperature; but he wished to emphasise the fact that it was the combination of the two which was so very fatal.

Influenza and the Weather of London.

BY

Sir ARTHUR MITCHELL, K.C.B., and Dr. BUCHAN.

This subject was investigated by us in the spring of 1890, and the results were published in the Journal of the Scottish Meteorological Society. In that paper are summarised the statistical facts relating to weather and influenza up to that date, extending from 1845 to 1890. These have been published in the weekly reports of the Registrar-General. Of the results then arrived at (that is, previous to the last epidemic), the following is a brief summary:—

It was found that the distribution of temperature and the distribution of deaths from influenza during the weeks of the year were inversely related; that when the mean temperature is low, the mean death-rate from influenza is high; and when temperature is high, the number of deaths from influenza is low. Further, the distribution of deaths from influenza is essentially the same distribution as that for bronchitis and pneumonia, or, speaking generally, for diseases of the respiratory organs.

Since registration of deaths commenced in London, deaths from diseases of the respiratory organs (*vide* Fig. 2)* have been shown to be most numerous during the winter months of the year; and, with some marked differences, there is substantial agreement in the annual distribution of deaths from the different diseases of the respiratory organs. During exceptionally severe winters and during dense fogs there is an exceptionally high mortality from bronchitis and pneumonia; and an enormous increase in the death-rate from these diseases during extremely cold weather and densely foggy weather has been an unvarying and apparently an inevitable consequence.

Similarly, deaths from heart disease (*vide* Fig. 6), including the other diseases of the circulatory system, and deaths from phthisis (*vide* Fig. 9), reach their annual maximum fatalness when the mean annual temperature is absolutely lowest, and when the east winds of early spring acquire their greatest frequency and malignancy respectively; and when it happens in any year that these features of the weather are more pronounced than usual, so is the excess of the mortality from these diseases also more pronounced.

Now when the death-rate from diseases of the respiratory organs, of the circulatory system, brain diseases (*vide* Figs. 7 and 8), or phthisis have strikingly exceeded the per-centages due to the temperature and fogs prevailing at the time, it has been found that something of an exceptional character has been in operation at the same time; and that

* The figures referred to are those contained in the preceding paper on *Meteorology in relation to Hygiene*, p. 98, *ante*.

something apparently lowering the public health has been the prevalence of influenza in a more or less epidemic form. At these times, it was noted that the diseases which were abnormally increased were, broadly speaking, just those diseases which annually go to swell the death-rate at the times of the year when influenza happened to be clearly epidemic. In other words, these were the diseases with which occurred the more serious complications with influenza.

It is remarkable that though during these 46 years the deaths from influenza were virtually restricted to the cold half of the year, yet when the epidemic set in, the degree of fatalness has been wholly uninfluenced by the changes of temperature, sometimes strikingly large and sudden, that occurred during the weeks when the mortality from influenza was great.

The last epidemic of influenza in London may be considered as having commenced about the middle of April 1891; the deaths in the third week of that month were 10, after which they rose with alarming suddenness week by week to the maximum of 319 in the third week of May; and since then the numbers have been 310, 303, 249, 182, 117, 56, 40, 29, 18, 17, and 6 in the first week of August. During these 16 weeks, the total number of deaths has been 1,925 recorded as caused by influenza alone, and to this must be added a very large number due to complications with other diseases.

The excess over the average mortality was comparatively small at all ages under 20; but above 20 the excess of the mortality rose steadily with age. Thus for the six weeks beginning with May 16th, the death-rate at 80 years and upwards was 117 per cent. above the average of the season. The deaths from influenza account only for a very small fraction of the increased total mortality of London during the epidemic. Other diseases showed an extraordinarily high death-rate of which the weather at the time affords no explanation; again pointing clearly to something of an exceptional character in operation at the time.

The weekly mortalities from the various registered causes of death have been compared with their averages for these weeks, with the result that during the epidemic the death-rate was enormously increased from diseases of the respiratory organs, the circulatory system, brain diseases, and phthisis.

Now the winter of 1890–91 was, in London, one of the severest on record, the mean temperature for the eight weeks beginning with the last week of November having been 10°·4 below the average. This unprecedentedly low temperature, prolonged through many weeks, was accompanied with a correspondingly high mortality, particularly from diseases of the respiratory organs and the circulatory system; and thus during last winter the death-rate was unusually large from these diseases.

The most noteworthy circumstance connected with the recent epidemic of influenza is the lateness in the season of the time of its occurrence, the time being the end of spring and the beginning of summer. All the previous epidemics, for which trustworthy weekly

INFLUENZA, 1891.

Per-centages by which the Death-rates of London, from different Causes of Death, were above or below the Means of the previous 10 Years, 5·5 per cent. being added for increase of Population. Figures in *italics* show a per-centage above the Mean; and figures in Roman type a per-centage below it.

—	Nov. 1890.		Dec. 1890.					Jan. 1891.				Feb. 1891.				March 1891.					April 1891.				May 1891.				June 1891.				
Week	47	48	49	50	51	52	53	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Mean temp.	7°·7	7°·0	6°·2	11°·0	13°·5	11°·7	10°·6	10°·8	7°·7	4°·5	5°·4	0°·6	1°·8	1°·4	1°·2	5°·3	5°·4	1°·9	0°·8	2°·0	7°·6	3°·6	4°·5	0°·6	2°·2	4°·4	7°·3	4°·8	2°·2	3°·6	3°·9	3°·9	2°·6
Sex:—																																	
Males	2	8	7	3	*25*	*16*	*34*	*24*	*18*	7	4	9	4	4	*13*	*14*	–	2	4	6	4	*11*	8	27	*28*	45	*38*	49	42	*28*	*32*	*14*	0
Females	9	5	2	1	*34*	*25*	*38*	*34*	*36*	*18*	1	11	12	7	*13*	*14*	9	4	12	1	2	5	8	22	*35*	*48*	37	*63*	*60*	*38*	*38*	8	9
Total	5	6	4	3	*29*	*20*	*36*	*29*	*27*	*12*	2	10	8	5	*14*	*14*	4	3	8	3	1	3	8	25	*31*	*46*	37	*55*	*50*	*33*	*35*	*11*	5
Ages:—																																	
0–5 years	10	24	4	6	2	3	4	4	1	3	12	27	23	11	3	3	13	12	20	9	12	12	10	4	1	*11*	4	*14*	*13*	1	4	8	23
5–20 "	6	14	1	8	15	14	3	*14*	6	30	20	10	20	4	11	7	17	8	4	–	4	5	7	9	10	*11*	*22*	*22*	2	7	2	6	10
20–40 "	1	1	6	5	*20*	*13*	6	*31*	*28*	1	14	15	3	2	*20*	*10*	*14*	7	3	–	2	1	*18*	*22*	*23*	*36*	*38*	*42*	*46*	*15*	*40*	*15*	*10*
40–60 "	1	2	*13*	4	*44*	*29*	*56*	*44*	*83*	*31*	*22*	7	9	1	*30*	*40*	*20*	7	8	*17*	8	*32*	*23*	*53*	*63*	*67*	*76*	*95*	*65*	*56*	*38*	*29*	*12*
60–80 "	*11*	4	*17*	*22*	*60*	*56*	*89*	*79*	*65*	*53*	*13*	11	11	9	*30*	*24*	2	*10*	3	*13*	*17*	*20*	*30*	*71*	*73*	*100*	*104*	*127*	*112*	*100*	87	*39*	*18*
80 "	8	*16*	*21*	*32*	*61*	*73*	*80*	*53*	*78*	*55*	*32*	7	9	4	*12*	*13*	20	6	8	5	7	*27*	*13*	*56*	*64*	*94*	*100*	*118*	*158*	*120*	*114*	*55*	*24*
Influenza	3	2	1	1	1	3	1	3	3	1	2	3	2	–	2	2	2	1	3	7	3	2	10	37	148	266	319	310	303	249	182	117	56
Circul. system	8	7	*30*	*23*	*55*	*30*	*30*	*41*	*42*	*27*	4	–	8	*19*	*33*	*32*	10	1	–	*26*	*19*	*40*	*56*	*40*	*35*	*35*	*46*	89	*80*	*51*	*52*	*20*	*14*
Pneumonia	*27*	6	*39*	*22*	*84*	*29*	*80*	*98*	*73*	*66*	*50*	3	*31*	*34*	*70*	97	*73*	*21*	*24*	*51*	*30*	*59*	*61*	*123*	*120*	*121*	*129*	*114*	*110*	*116*	*112*	*63*	*48*
Bronchitis	1	18	3	6	*62*	*79*	*104*	77	*88*	*46*	8	24	15	1	*41*	*30*	2	1	18	9	4	6	9	*40*	74	*111*	*116*	*142*	*152*	*109*	*128*	*40*	6
Pleurisy	*166*	9	30	*54*	*139*	*62*	*106*	*157*	–	*32*	*116*	7	*43*	*43*	*55*	*80*	*118*	*126*	3	*12*	*60*	*75*	*19*	*153*	*124*	12	24	*28*	50	*111*	30	*43*	*38*
Croup	32	40	*1*	24	56	33	33	36	41	47	60	33	14	40	20	7	50	25	*10*	18	36	16	23	30	18	48	22	31	9	92	46	54	53
All resp. organ diseases.	2	12	–	2	*60*	*58*	*82*	*70*	*68*	*42*	*13*	18	8	5	*42*	*37*	*11*	5	8	3	7	*18*	*22*	*60*	*72*	*95*	*100*	*116*	*119*	*91*	*99*	*39*	*14*
Phthisis	4	10	*15*	7	27	5	2	1	*14*	4	25	3	3	2	3	6	7	*10*	6	2	15	18	2	1	8	*26*	3	27	*19*	2	*15*	*11*	6
Enteritis	*21*	*53*	72	55	*78*	15	*45*	3	6	36	*75*	*73*	*14*	*22*	*93*	*91*	*92*	5	*29*	*23*	39	58	58	40	*83*	90	22	64	*26*	*122*	*15*	28	*17*
Apoplexy	2	15	2	*12*	*10*	4	*28*	*19*	7	2	*14*	*19*	16	8	29	*15*	14	7	2	*32*	*31*	1	9	65	*23*	*21*	*35*	*29*	12	3	*17*	6	24
All brain diss.	3	19	–	4	*10*	1	*12*	*12*	*14*	2	*13*	6	23	13	4	*13*	10	–	2	7	3	9	8	4	9	*13*	*18*	*25*	*13*	3	9	2	10
Epilepsy	14	*13*	*13*	*21*	*124*	*43*	1	40	*38*	67	*83*	*26*	15	67	13	69	21	27	*55*	*33*	*39*	*16*	*13*	67	54	57	42	*88*	*41*	19	*46*	*25*	*41*

statistics exist, occurred either in winter or early spring. From the termination of the severe weather of winter in the end of January to the outbreak of the epidemic in the middle of April, the death-rate from these diseases, as well as the general death-rate was very greatly less than what had been before and what followed. It was in truth the normal death-rate which was to be expected to accompany the, on the whole, greatly milder weather during these 12 weeks.

The mean temperature of the 11 weeks ending with June was exactly the average of past years, the weekly averages varying from 4°·4 above the average in the second week of May to 7°·3 below it in the following week. On the whole, then, the period was of the average temperature of the season, with fluctuations of temperature somewhat larger than usual.

In 1875 we showed* that from the middle of April to the end of June the death-rate from diseases of the respiratory organs, the circulatory system, brain diseases, and phthisis steadily diminish week by week, so that with the temperature and weather which actually occurred during this period deaths from these diseases might have been expected to have fallen off week by week.

But, with the setting-in of influenza, deaths from these diseases increased with alarming suddenness, even though, be it noted, deaths from the same diseases had been exceptionally heavy during the previous December and January.

The period of the year from the third week of April to the end of June is characterised by dryness and warmth, and statistics show it to be one of the healthiest times of the year. Indeed, at this time, no disease whatever shows a rapid increase in its death-rate, and only a few, notably bowel complaints, show the setting in of a rise in June from the annual minimum, as shown in Fig. 3.

Now, during this epidemic, no bowel complaint, with the single exception of enteritis, exhibited an increase in its death-rate; and further, no increase was apparent from any of those other diseases whose mean weekly death-rate at this season happens to be moderately high.

But the remarkable thing is this, it was just the same diseases whose death-rates were so exceptionally and enormously swelled during the influenza epidemic of January and February 1890 that have exhibited a similar exceptional and enormous increase to their death-rate.

It is a singular circumstance that in both the last influenza epidemics, the one a winter and the other a summer epidemic, croup has stood out as an exception to the other diseases of the respiratory organs, in uniformly showing a death-rate below its average; and, on the other hand, enteritis stands out as an equally striking exception to other bowel complaints, in exhibiting a death-rate above its average.

Accepting the mortality returns as revealing the diseases with which the complications with influenza occur, the important conclusion

* Journal of the Scottish Meteorological Society, Vol. IV., p. 187.

is arrived at that the complications of influenza are with special diseases only, irrespective of season. The increase to the death-rate from pneumonia, bronchitis, heart disease, and phthisis are equally enormous, whether the epidemic occurs at the season when their normal death-rates are highest, or at another season when the death-rates are falling to their annual minima.

In discussing the spread of the germs of diseases from one country to another by the intervention of winds, it has hitherto been universally assumed that is only the winds blowing over or near the surface of the earth which are concerned in the distribution of these germs. If these surface winds do not account for the successive appearances of the epidemic in different countries, it is concluded that the germs have not been transported by the winds.

This, however, is only a mode of looking at the subject which ignores the recent developments of meteorology and its teachings regarding atmospheric circulation through cyclones and anti-cyclones. As is now virtually proved, the winds in a cyclone are drawn inwards towards its centre, and then ascend in a vast aerial column to the upper regions of the atmosphere, whence again they flow as an upper current towards any anti-cyclone that may surround them. Thereafter they slowly descend along the centre of this anti-cyclone to the earth's surface, over which they are carried in every direction.

Suppose, for example, there were, as often happens, a cyclone in Russia, a vast column of air ascends from the surface, carrying with it particles of dust, germs, and other light impurities. These are then conveyed by the upper current to an anti-cyclone overspreading Western Europe, as in the supposed circumstances so often happens, and thereafter they descend to the surface with the descending current and are distributed over Western and Central Europe by winds from all points of the compass. Owing to the known rapidity of these aerial movements, two, or at most three, days are amply sufficient for this distribution.

DISCUSSION.

Dr. G. B. Longstaff, after paying tribute to the great importance and high value of the work of Sir Arthur Mitchell and Dr. Buchan, and expressing the hope that their collected papers would be republished in a more accessible form, pointed out that whenever a new disease appears medical men assign other diseases as the cause of death until the disease becomes prevalent, and that for this reason many of the deaths ascribed to bronchitis, &c. ought to have been recorded as cases of influenza. Nevertheless, the Registrar-General's returns afforded on the whole reliable average information, as was shown by the tabulation of enteritis and diarrhœa.

Dr. Gilbert stated that although the rainfall in February 1891 was smaller than that recorded in any previous month, the amount of nitrogen it contained in the form of ammonia and nitric acid was almost as great as that found in the rainfall of February in the two previous years, although this amounted to nearly 1 inch in 1890, and to 2 inches in 1889.

The quantity of chlorine in the water in February 1891, was the smallest on record, this being possibly due to the unusual absence of wind.

The Hon. Rollo Russell said that there were no authentic accounts of an attack of influenza occurring in mid-ocean or at any of our lighthouses. The disease was due to infection carried along the main lines of communication. The large towns were attacked in the first instance, and then the outlying districts. The march of influenza over Europe took the same lines and came from the same locality as cholera.

Dr. Tripe (Hackney) said that true influenza was invariably preceded by epidemic pneumonia. In Hackney, horses and cats during 1889–90 were attacked by influenza six weeks before any human beings, but during the last epidemic only a short time before.

Dr. Mortimer Granville had been much impressed by the apparent prominence of almost purely physical factors in the production, in influenza, of the high bodily temperature which had been considered characteristic of the disease. These factors were, first, the displacement of the blood from the centre to the periphery by the depression of vasomotor activity produced by the onslaught of the specific poison. whatever it was, that caused the malady; second, the conductivity of the atmosphere, dependent rather on density than temperature, although temperature came largely into play. He considered that this conductivity of the atmosphere was a factor of great importance in the production of high surface temperature, and that the duration of the disease depended especially on external conditions as regarded temperature, and particularly, as above stated, on the density of the atmosphere and its conductivity rather than on the personal state of the patient. After all other symptoms had disappeared a daily rise and fall of temperature was observed in the cases of persons resident in districts where the atmosphere is generally dense and cold. The weather played a most important part in determining the prevalence, the severity, and duration of the disease.

Mr. J. T. Roe supported the theory that the source of the influenza was to be found in the great floods in China and the resulting decay of large numbers of unburied bodies, and illustrated the possibility of the diffusion of the germs by a comparison with the distribution of dust from the Krakatoa explosion of 1883.

In reply to the Hon. Rollo Russell, **Dr. Buchan** stated that the outbreak of influenza at sea mentioned in his paper could only be accounted for on the theory of atmospherical distribution of the germs.

The President remarked that the great prevalence of influenza among members of the House of Commons appeared to be due to infection introduced by the witnesses who attended the Committees on the two important Railway Bills of the session.

Recent Hygienic Improvements in the Manufacture of Bread.

BY

JOHN GOODFELLOW, F.R.M.S., Hon. Consulting Chemist to the Master Bakers' Protection Society.

Bread is such a universal and important food that any improvements in its manufacture and quality deserve recognition and consideration,

and should prove interesting to all hygienists. It will be convenient if the subject be divided into two parts :—

1. Improvements in whole-meal bread.
2. Improvements in other breads.

The writer, from many experiments performed on himself, his assistants, and on young animals, for the purpose of his work on bread as a food, has come to the conclusion that ordinary whole-meal bread is not a desirable food and acts injuriously on the intestinal tract by unduly stimulating the muscles and nerve-centres of the bowels.

The chief objections to ordinary whole-meal bread as a food are :—

1. The large per-centage of waste, averaging about 12½ per cent.
2. The increased waste of other foods produced by the ingestion of whole-meal bread.
3. The unpleasant taste produced by the comparatively flavourless particles of bran.
4. The irritating action of the bran.
5. The rapidity with which whole-meal bread becomes dry and stale.

The large per-centage of waste is a most serious objection to ordinary whole-meal bread, especially if it be taken in large quantities. It constitutes a loss of energy to the body, inasmuch as force is used to digest the extra quantity of food which must be taken to equalize the waste.

The waste in fine white bread only amounts to about 4½ per cent., so that whole-meal bread is not nearly so thoroughly digested as white bread, and its ingestion leads to an increase in the waste of other foods.

In a subject experimented on by the writer, in December 1890, it was found that when milk alone was used as a food the waste averaged about 8 per cent.; but when ordinary whole-meal bread was used with the milk, the waste in the milk rose to nearly 11 per cent.

The irritating action of coarse whole-meal bread depends on the bran. The coarse bran particles act as mechanical stimuli, both to the nerve centres and the muscles, and unduly increase the peristaltic action of the intestines.

The stimulation often passes beyond the innocuous stage, and severe diarrhœa may be brought on by the excessive irritation of the bran. The writer has found indications that the villi of the intestines may be considerably modified by a continued ingestion of coarse bran, and he believes that this modification may have an effect in reducing the absorbing power of the villi.

Many medical authorities assert that slight chronic inflammation may result from the continual ingestion of coarse bran, and the author must admit that over and over again the post-mortem appearances of the animals he has experimented upon have been quite compatible with such a view.

The unpleasant flavour of coarse whole-meal bread is probably caused by the bran particles, which produce in the mouth an acute sense of *touch*, but not a very decided taste.

Some students undertook to test this point under the writer's direction, and they affirmed that flavourless particles very materially altered the taste of nearly every food tried.

They found, also, that the finer the particles the less they affected the flavour of the food with which they were mixed.

Objection number 5 is an important one. Very few people can partake of a stale whole-meal loaf with any degree of pleasure. It is well-known that staleness is not altogether due to a simple evaporation of water. There is a molecular change which goes on slowly, and which is an important factor in producing a stale loaf.

In ordinary whole-meal bread these changes go on very rapidly, and the bread after 24 hours is comparatively flavourless and distasteful.

The first four objections depend on the presence of coarse bran particles. It appears that very fine particles of bran do not produce such undesirable effects on the body as those which have been ascribed to coarse bran, so that the hygienic improvements in whole-meal bread must necessarily take the form of—

1st. Obtaining a *fine* bran in the loaf.

2nd. The preparation of so *dry* a meal that the bread takes up a large proportion of water, which is so intimately incorporated with the constituents as to delay those internal changes which result in a stale loaf.

Other minor improvements may also be referred to, affecting the digestibility, purity, flavour, &c., of the bread.

Number 1. Triticumina Bread.—This is a special whole-meal bread in which the bran particles are very fine, and shows what can be done in this direction. It is prepared from a special meal, ground by powerful steel machines, in which the bran is literally cut up into fine particles.

The waste in this bread, as ascertained by personal experiments, is only 7½ per cent., as compared with 12½ per cent. in ordinary whole-meal bread. The bran is so fine that it does not irritate the intestines like the coarse varieties of brown bread.

That it is perfectly possible to manufacture whole-meal bread which shall keep moist for two or three days is proved by the fact that this bread is palatable and soft after being kept three days. This is not only due to the moisture which it contains, but also to the large proportion of *soluble* matter present. The flavour of the bread is very pleasant owing to the large quantities of sugar and dextrin which it contains.

This bread is also distinctly very digestible. The starch is in a very assimilable condition, and there is about 50 per cent. more soluble matter present than in ordinary whole-meal bread.

This very desirable result is obtained by allowing the grain to undergo the first stages of germination, and subsequently kiln-drying it at a low temperature.

Number 2. "Cyclone" Bread is very interesting as marking a new departure in the preparation of whole-meal. The wheat grains are pulverized in sealed chambers by means of air-currents produced by fans

rapidly revolving in different directions. The grains are reduced to a state of fine division by their own momentum, and the result is a fine whole-meal. The advantages of this method are many. In the first place the meal is thoroughly aërated, and, secondly, there is no metallic or stony adulteration; thirdly, the meal is very free from microbes and other aërial impurities, for the air is filtered before being delivered to the chambers.

These two specimens demonstrate the possibility of manufacturing whole-meal bread in which the bran particles are so fine as to entirely obviate any irritating effects.

Improvements in non-whole-meal breads.

These may be divided into:—

1. Improvements in white bread.
2. Improvements in brown bread.

White bread is certainly deficient in proteid material, fat, and mineral matter. The reason of this is well-known. Fine white flour is obtained chiefly from the centre of the grain, and the bran and the germ are rejected. The bran and the germ are the portions of the grain richest in proteids, fat, and mineral matter, while the central part is poor in proteids and phosphates, and rich in starch.

Hence it follows that bread made from fine white flour is also deficient in nitrogenous matter, fat, and inorganic constituents, and is correspondingly rich in starch.

Any process, therefore, which secures:—

1. A higher per-centage of proteids;
2. " " fat;
3. " " phosphates;

may be regarded as an hygienic improvement in the quality of the bread. There appears to be a consensus of opinion that if a larger per-centage of our carbo-hydrate food took the form of soluble bodies (sugar and dextrin) the economy would gain considerably by such substitution. Any process, then, which secures this, may also be regarded as an hygienic improvement, inasmuch as the bread would be more digestible.

The standard ratio of nitrogenous matter to carbo-hydrate material may be taken as 1 is to 3·2. The ratio in ordinary fine white bread is as 1 is to 7.

Number 3. Black's Fermented Bread is a white bread which characterised by a high per-centage of nitrogen.

This result is obtained by a special process in which "strong flours" are taken and formed into dough, and then treated with lime water. The gluten is concentrated, and part of the starch precipitated so that a dough is obtained very rich in proteid material. This dough then added to ordinary dough, and the result is a mixture with a very high proportion of albuminoid matter.

This characteristic is obtained without any deterioration of texture or flavour, and the ratio of nitrogenous matter to carbo-hydrates is 1 is to 3·6, very near the normal.

This bread, though white, has quite as high a per-centage of proteid material as fine whole-meal.

Number 4. Diastase Bread is a variety with a very high per-centage of soluble carbo-hydrates, chiefly in the form of maltose. The starch is also in a very assimilable form. The bread has a very fine texture, and is one of the best flavoured of the white breads. It keeps moist far longer than ordinary white bread, for the diastase so acts on the starch as to produce soluble bodies which confer this characteristic on the bread.

The ratio of nitrogenous matter to carbo-hydrates is about the same as in ordinary fine white bread, but the bread is far more digestible, containing quite 80 per cent. more soluble carbo-hydrates.

This result is obtained by the addition of "diastase" to the dough, which acts on the starch, converting it into several forms of dextrin and sugar. The whole series of intermediate changes have not yet been fully worked out, but it appears that maltose is chiefly formed as a final product, and one of the achro-dextrins. The diastase does very little work during the doughing stage, but when the dough is introduced into the oven it rapidly acts on the gelatinized starch, until its power is destroyed by the heat of the oven.

The author has ascertained that 15 minutes is the average time during which the ferment acts on the starch in the oven, quite long enough for the diastase to produce a considerable quantity of sugar.

Brown Breads.

Number 5. Frame Food Bread.

This bread is made from ordinary white flour, to which an extract of bran is added. The extract is prepared by mechanical means from the bran, and consists of the following bodies :—

Water - - -	9·58
Carbo-hydrates - -	58·33
Proteids - -	21·40
Mineral matter - -	10·69
	100·00

The mineral matter is very rich in alkaline phosphates.

The extract may be added to the dough either as a powder or as a liquid, the object of the addition being to get a loaf having the same composition as whole-meal bread minus the bran particles.

The ratio of proteids to carbo-hydrate is as 1 is to 3·9, very much higher than in the case of fine white bread, and the bread contains 50 per cent. more mineral matter, consisting chiefly of phosphoric acid and potash.

Number 6. Germ Bread is manufactured from "germ" flour. Germ flour consists of about 75 per cent. of ordinary white flour, and 25 per cent. of the germ.

The germ being the embryo of the *Triticum* is rich in proteids, fat, and phosphates, and its retention in the flour adds materially to the nutritive value of the bread. The germ is specially treated in order to destroy the ferments and the bitter principle found in it. This bread is very rich in proteids, and contains far more fat and phosphates than ordinary bread. The ratio of proteids to carbo-hydrates is as 1 is to 3, slightly higher than the normal.

Number 7. Health Bread. This variety contains all parts of the wheat grain except the outer layers of the bran. The bread is thus free from irritating particles, while it retains the nutritious elements of the wheat. The ratio of nitrogenous matter to carbo-hydrate material is as 1 is to 3·6.

The process of preparation of the meal secures the rejection of the outer layers of the bran, consisting chiefly of woody fibre, while the inner layers containing the nutriment are retained and finely granulated.

I have only time to mention the existence of various malted breads, prepared by the addition of malt extract to the dough. Such breads are better flavoured and more digestible than ordinary bread, and there is very little risk of sourness. The malt favours quick fermentation, so that the souring germs are never allowed to develop in the dough, owing to the vigorous growth of the yeast and a minimum production of alcohol. The working is also cleaner, for potatoes need not be used when malt extract is employed.

Machine-made bread is coming more and more to the front, and rightly so. Such bread is surely to be preferred before hand-made bread, with the possible contingency of contamination from the bodies of the half naked operatives.

When it is impracticable to put down an extensive plant, hand-machines are used now in most bakeries, including such contrivances as kneaders, dough dividers, potato washing machines, flour blenders, &c.

The sanitary condition of bakehouses has of late years undergone much improvement, and it is rare indeed to find now-a-days dirty and unhealthy premises used for the purpose of bread-making.

I desire to record my sincere thanks to my assistant, Mr. D. J. Knightley, for the able manner in which he carried out my instructions while living on certain breads alone, and to my colleague Mr. C. H. Clarke, M.R.A.S., for confirming the analyses. I also wish to acknowledge my indebtedness to Dr. Frankland, F.R.S., for one of the analyses.

DISCUSSION.

Dr. Van Hamel Roos (Amsterdam) asked to what extent the mineral matter had been increased by adding lime water to the meal, and whether by lime water was meant a saturated solution of lime. He added, that, as editor of the "International Review of Adulterations," he was opposed to the adding of any foreign mineral matter to our food.

In reply to a question of Sir Roscoe as to whether copper salts were used in bakery in Holland, Dr. Van Hamel Roos answered that he never had found any in the meal and bread under his observation. Formerly it was met with in Amsterdam, but the adulteration was detected at once, as large crystals of copper sulphate were found in the bread. As to alum, he said that baking powders recommended as being used for improving bread on a large scale in England had been analysed by him and found to consist of alum. He thought these additions to meal and bread ought to be strictly prohibited.

Sir Charles Cameron said that it was undesirable to introduce indigestible and rough particles into the digestive organs. He had met many cases of suspected poisoning of oxen and sheep in which he was able to trace the real cause of death to the irritative action of undecorticated cotton cake, and even of other food stuffs. He thought the popular instinct was right when on the whole people preferred beautiful white bread, which they felt they could digest with comfort. Referring to Lawes' and Gilbert's experiments, Sir C. Cameron believed that a bread diet was more nitrogenous than a meat one, and therefore, that although white contained less nitrogen than brown bread, yet there was a sufficient amount of nitrogen in the former.

Mr. Cassal was glad that Dr. Van Hamel Roos had attended the Section, as he was editor-in chief of the very important "International Review of Adulterations," by means of which it might be hoped that in the near future united action would be taken by different countries for the suppression of adulteration. In regard to the use of sulphate of copper and alum in bread-making, he had always understood that the main object was to prevent fermentation from going too far when yeast was used, thus giving a badly coloured and acid bread; and also to enable damaged flours to be used by bakers.

Bromine and Iodine as Aërial Disinfectants; and on a new Method of Applying them.

BY

GERALD T. MOODY, D.Sc., and F. W. STREATFEILD.

The question of suitable aërial disinfectants for employment in hospitals, sick rooms, &c. is one of very great importance, and has not perhaps hitherto received the attention it deserves. Of the various substances employed, bromine has come largely to the front in recent years, and iodine has also been found to exert a considerable disinfecting action, although less than that of bromine weight for weight. Considerable difficulty has, however, been experienced in finding a suitable and convenient method of introducing these elements into the atmosphere. Various forms of lamps have been devised for the gradual volatilization of iodine and its diffusion through the air; and many have sought to effect the same purpose through the medium of the candle or night light. Whilst working in this direction, and with the endeavour to volatilize by means of a burning candle certain volatile brominated

organic derivatives of the aromatic series, it was discovered by one of the authors that *free* bromine vapour was evolved in quantity during the combustion of the candle. On extending the experiments to iodine derivatives a similar result was obtained. The authors therefore turned their attention to the preparation of a satisfactory bromine and iodine candle.

A modern candle is a very delicate piece of work, being the outcome of many years' experience and of much scientific and technical skill. Next to the proper refining of the fat or wax, the fabrication and chemical treatment of the wick are points of great importance, in order that the candle may burn with a bright flame, and free from cauliflower head. A very small quantity of a foreign body introduced into the substance of the candle causes a very marked effect on its combustion. Many of the disinfectants proposed for distribution by the aid of the candle caused it to burn very indifferently, and sometimes to be extinguished within an hour; or worse still, where it was sought to diffuse the vapour of certain balsamic or phenolic principles, the "disinfectant" itself underwent combustion and thus defeated the object in view. In the case where the free halogen was simply mixed with the combustible material of the candle, failure resulted from the escape of part of the halogen during storage, whilst the remainder gradually destroyed the material of the wick. After making numerous experiments the above-mentioned difficulties were overcome, and the authors succeeded in preparing candles and night-lights which do not undergo change on keeping, and by means of which any required quantity of the halogens bromine and iodine may be evolved with great exactness. This result has been accomplished by incorporating stable haloid organic compounds with the substance of the candle or night-night. Up to the present the most successful halogen compounds used have been dibromonaphthalene $C_{10}H_6Br_2$ and iodoform CHI_3. These substances are perfectly stable at ordinary temperatures, but when burnt under the conditions obtaining in a candle or night-light prepared from pure, well-pressed tallow, give rise to free bromine or iodine vapour respectively.

That the free halogen is evolved is shown by the odour produced; and its presence may be visibly demonstrated by the usual chemical method of holding at a short distance above the flame a piece of unsized paper moistened with a solution of starch and potassium iodide, which is rapidly turned blue.

The liberation of bromine and iodine during combustion may probably be explained on the assumption that the corresponding hydracids are formed in the first instance, and that these suffer decomposition at the temperature of the flame and in the presence of atmospheric oxygen into the free halogens and water, in accordance with the equations—

$$\text{(i.)}\ 4HBr + O_2 = 2H_2O + 2Br_2$$

Hydrogen bromide and oxygen give water and bromine.

$$\text{(ii.)}\ 4HI + O_2 = 2H_2O + 2I_2$$

Hydrogen iodide and oxygen give water and iodine.

The authors found that a very useful strength for general purposes is about 6 grains (0·3886 gram.) of either halogen compound in a 9-hour night-light; during combustion this will liberate bromine or iodine, the amount of which may be calculated as follows :—

The iodine night-light contains 6 grains of CHI_3, — C, $12 \times 1 = 12$; H, $1 \times 1 = 1$; I_3, $127 \times 3 = 381$; or, 394 grains of iodoform yield 381 grains of iodine; consequently 6 grains of iodoform in a night-light will give $\frac{381 \times 6}{394} = 5{\cdot}80$ grains of iodine liberated during the nine hours.

The bromine night-light contains 6 grains of $C_{10}\,H_6\,Br_2$; as before, — C_{10}, $12 \times 10 = 120$; H_6, $1 \times 6 = 6$; Br_2, $80 \times 2 = 160$; or the total 286 grains of dibromonaphthalene yield 160 grains of bromine, and consequently 6 grains of dibromonaphthalene will give 3·35 grains of bromine during nine hours.

By means of the above calculations it is easy to bring about the evolution of a stated quantity of either halogen, as during each hour's burning there will be evolved, of free iodine 0·64 grain, of free bromine 0·37 grain. By increasing or diminishing the quantity of the halogen compound mixed with the candle or night-light, any quantity of halogen, within reasonable limits, may be diffused.

The authors believe that the hygienic value of their discovery is very great, since it will make it possible for the vapour of bromine to be used as a household disinfectant in a safe and efficient manner and where it will be likely to do most good. It is especially for sanitary purposes that the bromine candle or night-lights are most likely to be useful, and there is no doubt they will prove of service for disinfecting closets, lavatories, and wherever sources of infection have to be guarded against. It must be understood that the bromine vapour evolved by the burning candle or night-light does not cause the slightest personal inconvenience in practice, candles containing about 6 grains of dibromonaphthalene having been burnt nightly by one of the authors during a period of two years. All the time the candle is burning the odour of bromine in the room is distinctly perceptible, but by no means disagreeable. Similar remarks apply to the iodine candle or night-light, which, besides being effective as a disinfectant and deodorant, has the advantage of possessing a therapeutical value in diseases of the throat, nose, and lungs.

DISCUSSION.

Mr. Cassal said that he had had occasion to examine these night-lights and could confirm the liberation of free iodine and bromine from them on burning, a fact which was in itself interesting; but he did not see that there was any special value attaching to such liberation for purposes of deodorisation or disinfection, and certainly not in regard to the latter.

INDEX.

A.

Page

onic, solvent of carbonate n hard waters - - 77
source of, in air - 93
carbonic, action of, on - - - - - 96
urous, in air - - 22
water on lead. (J. H. - - - 75
biting black smoke - 28
s Committee of Man-'ield Naturalists' Society 22
ia in, during fog - 17
gical examination of. ameron) - - 92
s of, re-breathed - 94
tance of biological ion of - - 92
ge towns; methods of - - - 22
wns, removal of smoke use for disinfecting (Sheridan Delépine and . Gomess) - - 37
ed in towns and cities, analysis of. (K. N. rji) - - - 88
ion - - - 8
of carbonic acid in - 93
rous acid in - - 22
mosphere - - 13
treatment of sewage - 45
air of large towns - 22
mney gases - - 31–4
posit formed on plant-. London - - 25
osit of fog constituents 14
, mechanical, to improve ting - - - 35
e, fog as an indicator of ve purity of - - 13
s, characteristic smell- - - - 90
c conditions, general, luce fog - - 16

B.

air during fog - 17
(K. N., M.D.). The ce of periodic analysis r breathed in towns and - - - 88
Barwise (S.), on lead pipes for conveyance of peaty water—and on Blackburn water - - 88
Beddington, vital statistics of parish of - - - 54
Benefit accruing from Acts prohibiting black smoke - - 28
Berlin sewage farms - - 59
Blackburn water. (S. Barwise) - 88
Black's fermented bread - - 114
Bouillon as affected by copper vessels - - - 66
Boulton (Alderman) on sewage irrigation at Burslem - - 63
Bread, Black's fermented - - 114
—— "Cyclone" - - - 113
—— Diastase - - - 115
—— diet. (Sir C. Cameron) - 117
—— Frame-food - - 115
—— Germ - - - 115
—— Health - - - 115
—— recent hygienic improvements in manufacture of. (John Goodfellow) - - - - 111
Breads, malted - - - 116
Bread, Triticumina - - 113
—— whole-meal, objections to - 112
Bremner (G. H.) - - - 62
Brewery waters, lime and magnesia in - - - - 87
Broad irrigation, utility of, for raw sewage - - - 47
Bromine and Iodine as aërial disinfectants. (G. T. Moody and F. W. Streatfield) - - 117
Brot, as affected by copper vessels - 66
—— der Zusatz von Kupfer zu, verbieten - - - 74
Buchan (Alexander M. A., LL.D.). Meteorology in relation to Hygiene - - - 98
—— —— on increased mortality in foggy weather - - 105
—— —— on outbreak of influenza at sea - - - - 111
—— —— and Mitchell (Sir Arthur, K.C.B.), Influenza and the weather of London - - 106

C.

Cameron (Sir Charles), on the digestive organs and bread diet - 117
—— —— on pipe water - - 88

Page

Cameron (Sir Charles), on biological examination of air - - 92
—— —— Experiments of Dr. Hammond in United States - 98
Carbonic acid, solvent of carbonate of lime in hard waters - - 77
—— —— effects of the respiration of. (Dr. Marcet) - - 93
—— —— gas, action of, breathed in volumes producing insensibility or death - - - 96
—— —— source of, in air - 93
Carpenter (Alfred). Croydon sewage - - - 63
—— —— Duty of a locality to utilise the nitrogenous matter in its sewage for the benefit of the nation - - - 48
—— —— Power of soil and vegetation combined to destroy disease germs, and so to prevent the possibility of the spread of enthetic disease in consequence of sewage farming - - 54
Cassal (Mr.). Copper in bread - 75
—— —— on suppression of adulteration - - - - 117
Chalk, magnesia in water derived from the - - - - 83
Chemical basis of epidemic disease 10
Chemical and physical processes employed in the treatment of sewage. (J. C. Thresh) - 40
Chemical treatment of sewage, with special reference to the treatment of London sewage. (A. Dupré) 39
Chimney gases, analysis of - - 31–4
Cities, periodic analysis of the air breathed in - - - 88
Clark's process, effects of, on magnesian waters - - - 86
Classification of physical and chemical processes resorted to in purification of sewage - - 41
Climate of London - - 99
Coal consumed in London - 15
Cohen (J. B.). Air Analysis Committee - - - 22
Colman (H. G.) on tin poisoning - 75
Colouring matters of town fogs - 13
Combustion, conditions to be observed in order to effect complete - - - - 29
—— visible smoke the result of imperfect - - - 29
Continuous oxidation of lead in water, air necessary for the - 79

Pa

Copper in bread. (Mr. Cassal) -
Courtney (Mr.) on a hand-fired furnace - - -
Cripps (Mr.). Metropolitan sewage system at Tottenham - -
Crops, sewage as food for growing -
Croup exhibiting a death-rate below its average during influenza epidemic - - -
Croydon, results of sanitation in -
—— sewage. (A. Carpenter) -
"Cyclone" bread - - -

D.

Danzig sewage farm - -
Delépine (Sheridan) and Gomes (Alfred B.), demonstration of the possibility of removing the smoke of fires from the air of towns and of using it for disinfecting sewers - - -
Deposit formed on plant-houses in London, analysis of - -
Deposits, solid, on leaves of shrubs
Determining cause of fog - -
Diarrhœa, summer, in relation to temperature - - -
Diastase bread - - -
Diseases, parasitic, and sewage farms - - - -
Disinfectants (aërial), Bromine and Iodine as. (G. T. Moody and F. W. Streatfield) - -
Disinfection and sterilization of sewage - - - -
Drysdale (C. R.) on sewage farming - - -
Dupré (A., F.R.S.), chemical treatment of sewage, with special reference to the treatment of the London sewage - - -
Dust as a determining cause in the formation of fog - -
—— filtered out of air - -
Duty of a locality to utilise the nitrogenous matter in its sewage for the benefit of the nation. (Alfred Carpenter) - -
Dwellings, effects of ill-ventilated -
Dyer (Professor Thiselton), description of a fog deposit collected at Kew - - -
—— ——, effect of fog on plants under glass - - -

Page

E.

al, against black smoke - 28
fog on health - - 10
ɔg on plants grown in the
at Kew. (W. Watson) - 21
he respiration of carbonic
man. (W. Marcet) - 93
ı (Dr.), inquiry as to the
of the respiration of car-
cid on man - - 97
exhibiting a death-rate
its average during in-
epidemic - - 109
disease rests on a
al basis - - - 10
affected by copper vessels 67
ɔn of organic matter in
- - - - 25
ulphurous acid in air - 23

F.

, means for preventing
ɔn of smoke from. (A.
cher) - - - 28
von Gemüseconserven,
ıdung von Kupfer zur - 74
'erlin sewage - - 59
ffected by copper vessels - 66
ı, chemial, of sewage - 43
rough land, intermittent
ard of sewage - - 46
lead tanks, paralysed - 88
(Alfred E.). Means at our
ıl for preventing the emis-
smoke from factories and
welling-houses - - 28
at Kew, effect of fog on - 21
- - - - 20
ın increaser of death-rate - 100
indicator of the relative
of atmosphere - - 13
ıntry - - - 13
termining cause of - - 16
st as a determining cause
formation of - - 11
'ects of, on health - 16
'ects of, on plants grown in
ɔuses at Kew. (W. Wat-
- - - - 21
gh - - - 16
e general atmospheric con-
s inducing - - - 16
a - - - - 13
ıow during, analysis of - 25

Page

Fog, sulphur as an active producer
of - - - - 11
Fogs, town - - - - 13
—— ——, and their effects. (W.
J. Russell, F.R.S.) - - 11
Frame-food bread - - - 115
Frank (Johann Peter), on copper
poisoning - - - 70
Frankland (Percy F., F.R.S.),
What is the importance of mag-
nesia in drinking water? - 82
Friedricks Blätter, 1887 (copper
poisoning) - - - - 71
Fuel, gaseous - - - 35
Furnace, hand-fired. (Mr. Court-
ney) - - - - 37

G.

Garrett (J. H., M.D.). Action of
water on lead - - - 75
Gas, as a smokeless fuel - - 36
——, carbonic acid, action of,
breathed in volumes producing
insensibility or death - 96
——, consumed in London in dense
fog, additional amount of - 20
——, conversion of coal into, for
fuel - - - - 35
Gases, analysis of chimney - - 31-4
Gautier, on copper poisoning - 65
Gemüseconserven (copper poison-
ing) - - - - 65
——, Verwendung von Kupfer zur
Färbung von - - - 74
Germ bread - - - 115
Germs of diseases, spread of, by
winds - - - - 110
Gibbon (Dr.), on systematic chemi-
cal and bacteriological examina-
tion of air - - - 93
Gilbert (Dr.), on nitrogen and
chlorine in the rainfall of Febru-
ary 1891 - - - 110
Gilbert (J. H.), application of
sewage to land - - 61
Gomess (Alfred B.) and Delépine
(Sheridan), demonstration of the
possibility of removing the smoke
of fires from the air of towns
and of using it for disinfecting
sewers - - - - 37
Goodfellow (John). Copper sul-
phate in bread - - - 75

Page

Goodfellow (John), Recent hygienic improvements in the manufacture of bread - - - 111
Granville (Dr. Mortimer), influenza - - - 111

H.

Hammond (Dr.). Experiments of, as to expired air. (Sir C. Cameron) - - - 98
Hand-stoking, evils of - - 30
——, mechanical appliances to avoid evils inherent in - - 35
Hardness, permanent, in water - 86
Hart (Ernest) on fogs in connexion with asthma - - 26
Hartog (Philip), Air Analysis Committee of Manchester Field Naturalists' Society - - 22
Haughton (Edward) on smoke abatement - - - 26
—— —— on sewage disposal 63
Health bread - - - 115
Heller und von Pleischl, Kupfermassenvergiftung - - 71
"High" fog - - 16
House smoke - - - 36
Hygienic improvements in the manufacture of bread. (John Goodfellow) - - - 111
Hygiene, meteorology in relation to. (Alexander Buchan) - 98
—— Mosaic - - - 49

I.

Ill-ventilated dwellings, effects of - 95
Importance of magnesia in drinking water. (Percy F. Frankland) - - - 82
Influenza, Dr. Mortimer Granville on 111
—— and the weather of London. (Sir A. Mitchell, K.C.B., and Dr. Buchan) - - - 106
—— at sea. (The Hon. Rollo Russell) - - - 111
—— —— (Dr. Buchan) - - 111
—— complications of - - 110
Iodine and bromine as aërial disinfectants. (G. T. Moody and F. W. Streatfield) - - 117

J.

Jones (Colonel) on sewage farming 62

K.

Page

Kew, effects of fog on plants grown in the houses at. (W. Watson) 21
Kritische und experimentelle Studien über die hygienische Bedeutung des Kupfers. (K. B. Lehmann) - - - 63
Kupfer, der Zusatz von, zu Brot verbieten - - - 74
—— Verwendung von, zur Färbung von Gemüseconserven - 74
Kupfergeschmack (in foods) - 65 et seq.
Kupfers, studien über die hygienische Bedeutung des. (K. B. Lehmann) - - 63
Kupfervergiftung, chronische - 71
Kupfervergiftungen, akute ökonomische - - - 71

L.

Landriset, proportion of carbonic acid in the atmosphere - - 93
Lead, action of water on. (J. H. Garrett) - - - 75
—— —— mainly due to presence of nitrate - - - 81
—— continuous, oxidation of, in water - - - - 79
—— effects on oxidation of, by coupling different metals - 79
—— pipes for conveyance of peaty water. (S. Barwise) - - 88
Lehmann (Prof. K. B.), carbonic acid in atmosphere - - 27
—— ——, effect of tin on the system - - - 75
—— ——, Kritische und experimentelle Studien über die hygienische Bedeutung des Kupfers - - - 63
Leicester sewage - - - 59
Lias, proportion of magnesia greater in the water from the - 83
Light, absorption of, by town fogs - 18
London climate of - - - 99
——, County Asylum sewage farm 5[illegible]
Longstaff (Dr. G. B.), meteorological curves and curves of deaths - - - 1[illegible]
—— ——, on the Registrar-General's returns - 1[illegible]

M.

Page
mportance of, in drink-
r. (Percy F. Frank- - - - 82
ıking water, analytical - - - - 84–5
: la Source (copper in - - - - 65
V. R.) on the Dublin ply - - - 82
ds - - - 116
e of bread, recent hy- provements in. (John ›w) - - - 111
, M.D., F.R.S.) On the the respiration of car- l on man - - 93
n) on smoke in Man- - - - 37
tts, Report of State Health of, on sewage - 59
›ur disposal for pre- he emission of smoke ›ries and from dwelling- (A. E. Fletcher) - 28
cers of health, extracts ›orts of, *re* Croydon arm - - 56, 57
ects of coupling diffe- ›xidation of lead - 79
r in relation to hygiene. ler Buchan) - - 98
ir Arthur, K.C.B.) and Dr.), Influenza and the ›f London - - 106
rald T.) and Streatfield, Bromine and Iodine as sinfectants; and on a ›od of applying them - 117
›hole annual of London, r - - - 99
r of London - - 100
iene - - - 49
ıitrification - - 46

N.

›r.) on air of coal mines 93
opper poisoning - 71
water, oxidation of lead t on - - 81
of sewage - - 46
.) on meteorology in o hygiene - - - 105

O.

Page
Odling (Professor), effect of inhalation of pure carbonic acid gas - 98
—— ——, analysis of air for sanitary purposes - - 92
Oliver (Prof. F. W.), injuries by fog to vegetation - - 26
Organic matter in air, estimation of - - - - 25
—— matters in sewage, oxidation of - - - - 45
Organisms found in sewage - 58
Oxidation of lead in water - - 79, 81
—— ——, effects of coupling different metals on - - 79
Oxidation of organic matters - 45
——, result of primary action of water on lead - - 76

P.

Parasitic diseases and sewage farms 58
Perry (T. J.), radial method of distributing sewage - - 62
Pipe-water. (Sir C. Cameron) - 88
Plants, deleterious action of town fogs on - - - 17
Plants grown in the houses at Kew, effects of fog on. (W. Watson) 21
Plants in active growth greatest sufferers from fog - - 21
Pleischl, von., und Heller "Kupfermassenvergiftung" - - 71
Possibility of getting rid of town fogs - - - - 20
—— of the spread of enthetic disease in consequence of sewage farming. (Alfred Carpenter) - 54
Power of soil and vegetation combined to destroy disease germs. (Alfred Carpenter) - - 54
Precipitation of sewage - - 44
Presidential address. (Sir Henry Roscoe) - - - 7
Processes, chemical and physical, employed in the treatment of sewage. (J. C. Thresh) - 40
Purley, letter from London County Asylum at - - - 5

R.

Raffles (Hargreaves) on the collection and comparison of statistics relating to town fogs from large cities - - - 27

Page

Raffles (Hargreaves), on the distance at which objects were visible during a London winter - - 19
Re-breathed air, effects of - - 94
Report on sewage by State Board of Health, Massachusetts - - 59
Reports of the medical officers of health in *re* Croydon Sewage Farm, extracts from - - 56
Respiration, artificial, in carbonic acid poisoning - - - 98
—— of carbonic acid, effects of, on man. (Dr. Marcet) - - 93
Result of continuous application of sewage to same land - - 55
Results of estimation of sulphurous acid in air - - 24
—— of experiments on re-breathing air - - - - 95
—— of sanitation in Croydon - 56
Riche, copper in foods - - 65
Rideal (Dr.) on reduction of nitrate to nitrite during lead oxidation - 82
Roe (J. T.) on the source of influenza - - - 111
Röchling (H. Alfred), Leicester sewage and Berlin sewage farms 59
Roos (Dr. Van Hamel) on adulterations - - - - 116
Roscoe (Sir Henry) on sewage disposal - - - 59
Roscoe (Sir Henry, M.P., F.R.S.), Presidential Address - - 7
Russell (Dr.) on London fogs 105
—— —— on copper - - 75
—— —— on town fogs and their effects - - - - 11
—— (The Hon. Rollo) influenza at sea - - - - 111
Rye grass, power of, to deal with organisms found in sewage - 58

S.

Salt as an active fog producer - 11
Saunders (C. E.) on treatment of sewage by broad irrigation - 62
Sewage, as food for growing crops, or broad irrigation - - 47
—— chemical and physical processes employed in treatment of. (J. C. Thresh.) - - 40
—— chemical treatment of. (A. Dupré) - - - 39
Sewage farming, prevention of spread of enthetic disease in consequence of. (Alfred Carpenter.)
—— —— (C. R. Drysdale.) -
—— irrigation at Burslem. (Alderman Boulton.) - -
—— Leicester - - -
—— of London, utilisation of, on land - - -
—— organisms found in - -
—— processes resorted to in purification of - - -
radial method of distributing. (T J Perry. - - -
result of continuous application of, to same land - -
—— system, metropolitan, at Tottenham - - -
Sewerage, "separate" system of -
Sewers, use of smoke of fires for disinfecting. (Sheridan Delépine and Alfred B. Gomess.) -
Sillar (W C.) on the ABC process of treating sewage - -
Smith Dr. Angus), investigations of on re-breathed air - -
Smoke from factories, means for preventing emission of. (A. E. Fletcher.) - - -
—— house - - -
—— of fires, possibility of removal of, from air of towns. (Sheridan Delépine and Alfred B. Gomess.)
Snow during fog - -
Source of carbonic acid in air -
State Board of Health of Massachusetts, Report of, on sewage -
Statistics, vital, of Beddington -
—— —— of Wallington - -
Sterilization and disinfection of sewage - - -
Stoking by hand - - -
Straining and filtration of sewage, mechanical - - -
Streatfield (F. W.) and Moody (Gerald T.), Bromine and Iodine as aërial disinfectants - - 1
Subsidence process for sewage purification - - -
Sulphur as an active fog producer -
Sulphurous acid in the air - -
Summer diarrhœa and temperature 1
Sussex County Lunatic Asylum sewage farm - - -

T.

Page

.), Air Analysis Com-
the Manchester Field
s' Society - 22
gin) on domestic smoke 27
increasing rate of
water on lead - - 78
hn C.), chemical and
processes employed in
nent of sewage - - 40
. H.), cause of fogs in
ns - - - 27
oisoning by. (H. G.
- - - 75
- - - 13
and their effects. (W.
ll, F.R.S.) - - 11
power of absorption of
- - - 18
thods of analysis of air
- - - 22
lic analysis of the air
in - - - 88
of sewage, electrical - 44
), fog as an increaser of
- - - 26
on meteorology in re-
hygiene - - - 105
on influenza - - 111
a bread - - 113

U.

of sewage as food for
crops, or broad irriga-
- - - 47

W.

n, vital statistics of the
of - - - 55

Page

Warrington, on nitrification - 46
Water acid, action of, on lead - 76
—— action of, on lead. (J. H. Garrett.) - - - 75
—— faintly acid, action of, on lead 80
—— slightly alkaline, action of, on lead - - - 80
—— strongly acid, action of, on lead - - - 80
—— faintly alkaline or neutral, action of, on lead - - - 76
—— strongly alkaline, action on lead - - - 76
—— from the lias, magnesia in - 83
—— importance of magnesia in. (Percy F Frankland.) - 82
—— lead pipes for conveyance of peaty. (S. Barwise.) - 88
magnesia in drinking, analytical table - - - 84–5
—— neutral or faintly alkaline, action of, on lead - - 76
—— peaty, action on lead - 81, 88
—— shallow-well, permanent hardness of - - 86
Waters, brewery - - - 87
calcareous, contain little magnesia - - - 83
—— Clark's process on magnesian 86
Watson (W.), Effects of fog on plants grown in the houses at Kew - - - 21
Weather of London and influenza. (Sir Arthur Mitchell and Dr. Buchan.) - - - 106
Wein, as affected by copper vessels 67
Whole-meal bread, objections to - 112
Williams (Dr. C. Theodore) on London fogs - - - 26
Winds as a means of spreading germs of diseases - - 110
Winter mortality of London - 100

LONDON: Printed by EYRE and SPOTTISWOODE,
Printers to the Queen's most Excellent Majesty.

TRANSACTIONS

OF THE

Seventh International Congress of Hygiene and Demography.

LONDON, AUGUST 10TH–17TH, 1891.

Patron:—HER MAJESTY THE QUEEN.

President:—H.R.H. THE PRINCE OF WALES, K.G.

VOLUME VI.

SECTION VI.

ARCHITECTURE IN RELATION TO HYGIENE.

EDITED BY C. E. SHELLY, M.A., M.D.,
Assisted by the HONORARY SECRETARIES of the SECTION.

LONDON:
PRINTED BY EYRE AND SPOTTISWOODE,
PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY.

1892.

- 16362 -

ASTOR LIBRARY
JUN
6
1893
NEW YORK

OFFICERS OF THE SECTION.

PRESIDENT.

SIR ARTHUR W. BLOMFIELD, M.A., A.R.A., F.R.I.B.A.

HONORARY PRESIDENTS.

Don MARIANO BELMÁS, Madrid.
P. J. H. CUYPERS, Amsterdam.
AUGUSTE CHOISY, Paris.
Herr HERMANN ENDE, Berlin, N.W.
Professor LUDWIG PETER FENGER, Copenhagen, K.
Professor FRANZ RITTER VON GRUBER, Vienna.
ACHILLE HERMANT, Paris.
Professor F. MELDAHL, Copenhagen.
Dr. REICHENSPERGER, Cologne.
Comte de SUZOR, St. Petersburgh.
Chevalier J. DA SILVA, Lisbon.
Professor ÉMILE TRÉLAT, Paris.
Professor WM. WARE, New York, U.S.A.

VICE-PRESIDENTS.

GEORGE AITCHINSON, A.R.A., F.R.I.B.A., Professor of Architecture at the Royal Academy.
THOMAS BLASHILL, F.R.I.B.A., Superintending Architect to the London County Council.
EWAN CHRISTIAN, Past President R.I.B.A., Royal Gold Medallist.
T. E. COLLCUTT, Member of Council, R.I.B.A.
ARTHUR CATES, Vice-President R.I.B.A.
A. H. DOWNES, General Inspector, Local Government Board.
R. W. EDIS, F.S.A., F.R.I.B.A.
ROGERS FIELD, B.A., M.Inst.C.E.
BANISTER FLETCHER, D.C.L., F.R.I.B.A., Professor of the Arts of Construction, King's College (Lond.).
T. HAYTER LEWIS, Past Vice-President R.I.B.A., Emeritus Professor of Architecture.
F. J. MOUAT, M.D., LL.D., F.R.S.
D. CUBITT NICHOLS.
JOHN SLATER, B.A., Lond., Member of Council, R.I.B.A.
PERCIVAL GORDON SMITH, F.R.I.B.A., Architect to the Local Government Board.
T. ROGER SMITH, F.R.I.B.A., Professor of Architecture, University College (Lond.).
H. SAXON SNELL, F.R.I.B.A.
HY. HEATHCOTE STATHAM, F.R.I.B.A.
WILLIAM WHITAKER, B.A., F.R.S., F.G.S.
G. B. LONGSTAFF, M.B., F.R.C.S., L.C.C.

COUNCILLORS.

F. T. BAGGALLAY, F.R.I.B.A., President, The Architectural Association.
ERNEST S. GALE, Hon. Sec., The Architectural Association.
T. H. HARRISSON, F.R.I.B.A., President, Liverpool Architectural Society.
H. L. BECKWITH, F.S.A., Hon. Sec., Liverpool Architectural Society.
W. H. THORP, F.R.I.B.A., President, Leeds and Yorkshire Architectural Society.

SECTION VI.

ARCHITECTURE IN RELATION TO HYGIENE.

Tuesday, 11th August, 1891.

The PRESIDENT, Sir ARTHUR BLOMFIELD, in the Chair.

Presidential Address

BY

Sir ARTHUR W. BLOMFIELD, M.A., A.R.A., F.R.I.B.A.

After the inaugural ceremony of yesterday, and the admirable address in which the Prince of Wales gave so cordial a welcome to the visitors of this great International Congress, you will doubtless be anxious to begin the work which lies before us in the next four days with the least possible delay.

I shall not, therefore, detain you with a lengthy address in opening the business of this Section.

Its title, "Architecture in relation to Hygiene," is clear and precise, but it has no doubt occurred to many who have read it that it involves a question to which it is by no means easy to give a clear and precise answer, "What is the relation of architecture to hygiene?"

The difficulty of answering lies in the uncertainty as to the strict limits of the functions and duties of the architect.

One of the greatest of our English authorities on the subject—the late Mr. Fergusson—in the introduction to his well-known handbook, defines architecture to be "The art of ornamental and ornamented construction," and further on, speaking of the architect, he says, "It "would be well if, in most instances, he could delegate the mechanical "part of his task to the engineer, and so restrict himself entirely to "the artistic arrangement and ornamentation of his design."

If this view of architecture and of the legitimate duties of the architect were generally accepted as correct, the relation of architecture to hygiene would be reduced at once to something which is not always easy to trace or grasp, and which has never yet received the full amount of serious and careful attention that it well deserves. In that case most, if not all, of the valuable and interesting papers, which we are about to hear and discuss, would have to be addressed to some other more purely scientific section.

If, on the other hand, we take the more usual definition of architecture as "the art and science of building," its relations to the

science of hygiene at once become too varied and too complex to admit of clear and concise description. A vast field is at once opened out before us, in which it is often extremely hard, sometimes even impossible, to indicate with precision the line of demarcation between the domain of the architect and those of experts in other branches of science. As one out of many illustrations which might be cited of this difficulty, I may mention the wide and interesting subject of paving, which plays so important a part in the health, comfort, and well-being of communities. This large question seems to occupy a kind of neutral ground between the province of the architect and that of the civil engineer.

Many other similar instances might be given, but this one will be sufficient to show that the selection of subjects to be dealt with by this section must always be a matter of considerable difficulty.

Directly scientific considerations are admitted side by side with the purely æsthetic aspect of architecture, it becomes hard to name a subject for discussion at a Congress of Hygiene which would not be as suitable for an engineering, medical, or other scientific section as it is for that of architecture.

For this reason I venture to throw out the suggestion that for some future meeting of this Congress an extremely interesting and instructive paper might be written dealing exclusively with the points of contact between hygiene and the purely æsthetic side of architecture.

This branch of a great subject remains up to the present time practically almost untouched, perhaps partly from the fact that to many minds the attempt to establish any such relationship appears fanciful and unpractical. It is well known that one of the greatest of our English pioneers of sanitary science, the late Sir Edwin Chadwick, viewed the idea of any such connexion with disfavour, and even with anger; he seemed, indeed, to think that art and hygiene were not only unconnected, but even in some respects incompatible.

Notwithstanding this decided opinion of a great and deservedly respected authority, I do not think it would be difficult to show that such a connexion has, at any rate for certain minds and constitutions, a very real existence; neither would it be hard to prove that, although never perhaps closely followed up or fully worked out in all its bearings, the idea of some actual relation between beautiful and artistic surroundings and health, must have been present in the minds of many writers both ancient and modern. Time forbids me to do more than instance a very few examples.

I cannot refrain from giving one of great weight and venerable antiquity which I find in the third book of Plato's "Republic."

"Let our artists," he says, "be those who are gifted to discern
" the true nature of beauty and grace; then will our youth dwell in
" the land of health, amid fair sights and sounds; and beauty, the
" effluence of fair words, will visit the eye and the ear, like a healthful
" breeze from a purer region, and insensibly draw the soul, even in
" childhood, into harmony with the beauty of reason."

Thus, it would appear, the great philosopher held that the finest productions of art, acting through the eye on the mind, exercise a distinct influence on bodily health; and if, as Emerson tells us, "Out "of Plato come all things that are still written and debated among "men of thought:" we may take this passage as a type of many similar thoughts scattered through the works of numberless authors from his day down to the present time. May not the same idea be traced in the much-quoted line of our own poet Keats, "A thing of beauty is a joy for ever"? But instances will not be found wanting of more direct reference to a real connexion between the beautiful in art, and especially in architecture, and the science of health, or hygiene.

Eight years ago the late E. W. Godwin read before a meeting at the Health Exhibition, then being held in London, an elaborate and masterly paper on "Dress in its relation to Health and Climate." In the course of a parallel which he draws in that paper between dress and architecture, he says: "Science and art must walk hand in hand, if "life is to be worth living. Beauty without health is incomplete. "Health can never be perfect for you so long as your eye is troubled "with ugliness." He goes on to point out that long habit will no doubt accustom most people to any degree of ugliness, so that the mind untrained in Art is seldom perhaps consciously troubled by it. But notwithstanding this apathy, a legitimate source of intellectual enjoyment is lost, and doubtless with it an appreciable element of health in its highest perfection; a loss which it is the business of the architect in some degree to supply by providing beautiful objects to satisfy and delight the eye, and by waging war with everything that is mean, ugly, and squalid.

At present, no doubt, large masses of people are still so habituated to these last characteristics in their every day surroundings that they scarcely feel a wish for anything better, just as they will get accustomed to evil smells, and to a vitiated atmosphere which they breathe quite unconscious of its insidious and deadly effects on their health.

But if education and culture continue to advance as they have done in the last fifty years, and habits of intelligent observation are fostered and encouraged, the eyes of the masses will every day become more sensitive and fastidious; the dreary and monotonous streets and badly designed buildings which a few years ago would have been passed unnoticed, will soon begin to exercise a distinctly depressing and disturbing influence on the mind, which cannot fail to have some ill-effect on the health, comfort, and general well-being of the community.

It is now, I believe, a recognised fact that certain colours, quite apart from the nature of the pigments or dyes which yield them, produce very decided effects, both on the mind and body when in certain conditions.

It is probable that the same is true of certain combinations of colours and even of forms in which the skill and taste of the artist must be paramount, and in which the aid of science, however necessary, can only be looked upon as subsidiary.

Valuable hints and suggestions bearing on this subject may be gathered from a lecture delivered many years ago at the Royal Instistitution by Cardinal Wiseman, entitled, "Points of contact between Science and Art." Also from an address delivered by Mr. Wyke Bayliss, President of the Royal Society of British Artists, "On Sanitary Reform in relation to the Fine Arts," at the Sanitary Congress held at Hastings in 1889.

As might naturally be expected from such a source, it teems with beautiful and poetical thoughts bearing on the subject. He shows how ruinous are dirt and disorder to the best interests of art, and how all artists must hail every onward step in sanitary reform as not only conducive to bodily health, but to the growth and progress of art. The whole cannot fail to be read with as much pleasure as profit, and anyone who desires to follow out the line of thought I have suggested in tracing a direct connexion between architecture as a fine art and hygiene, will do well to study this address with great care and attention. But the illustrations, arguments and advice made use of are directed more to the influence of sanitary reform on the growth and development of art than on the effect of art on health, a more obscure perhaps, but no less interesting subject, and the one I desire to see dealt with.

I have left until the last all mention of the only writer who, as far as I know, has ever made any serious attempt to deal systematically and in detail with this interesting subject.

Some years ago my friend Dr. B. W. Richardson, who stands in the foremost ranks of sanitary authorities, delivered a lecture upon it, which, I am afraid, is now out of print, and I have been unable to obtain a copy; but he has kindly furnished me with some information about it.

He tells me that the principal points he dwelt on were as follows:—

He began by showing that much prejudice has been excited against some of the best sanitary inventions and labours, because leading sanitarians have failed to consider artistic construction as part of sanitary construction; their whole minds have been absorbed in the useful, and they have permitted all that is ornamental to pass by as if good taste were disconnected from sanitation. He argued that this was a grand mistake; that ugliness was an offence to good health, and that beauty was an aid to the best health.

He showed that when mind and body are enfeebled by bad health, the introduction of disagreeable objects into the sick room or ward is painful and injurious to the occupants; whilst the presence of beautiful flowers, pictures, and designs is curative in its effects; a kind of mental tonic which gives tone also to the body. This thought led him to the consideration of the best forms for hospital wards having regard to the effect on the eye, and through the eye on mental and bodily health, and so with all the details of visible construction and of decoration.

Speaking of the dwelling house he maintained that no part ought to be excluded from the possession of architectural art, because it is the tendency of the human mind to let that which is disagreeable, plain, and ugly go without regard and accumulate dirt and disorder. Hence all

the offices of a house should have as much care bestowed on them as the living rooms to render them bright and cheerful, and to make cleanliness as obvious a necessity in one as the other. In this lecture Dr. Richardson made a great point of the treatment of floors, adverting particularly to the Ancient Roman mosaic floors which were not only beautiful works of art, but easily cleaned, and which by the well-known hypocaust system of warming diffused an equable and agreeable warmth through the room without draughts.

Other points especially dwelt upon were the treatment of roofs, and the introduction of artistic water fountains in different parts of the house.

No one could be found better qualified than Dr. Richardson to speak with authority on both the aesthetic and the scientific aspects of the question "What is the relation of Architecture to Hygiene;" but even when writing in the interests of art he is naturally first of all a man of scienc, and I should like to see the same subject dealt with by an architect from an artist's point of view.

Professor Fenger (Copenhagen) said that architects on the continent looked in many directions for instruction, but not so often to England as to continental countries; but the conviction is dawning upon them that in one respect England has taken a prominent part among the nations of Europe since the beginning of this century, namely, in sanitary house-building, as well as in the construction of separate wards in hospitals. Now they can scarcely build without being indebted to England for ideas. He concluded by proposing a vote of thanks to the President for his presence in the chair, and for his admirable address.

Mr. Charles Lucas (Paris) fit des remerciements à M. le Président pour son adresse sur la necessité de l'alliance de la Beauté et de l'Art, le souvenir donné aux regrettés Chadwick et Godwin.

The proposal was carried by acclamation.

On Open Spaces.

Read by the Earl of Meath.

[Prepared by Mrs. Basil Holmes, Hon. Sec. to the Metropolitan Public Gardens Association.]

If we could transport ourselves into the England of 200 years ago, or if we were even able to see what our great grandfathers looked upon, how hard it would be to recognise the sites of those places which are now so familiar to us. A great part of the land was common land, or lammas land, heaths, downs, forests, woods, moors, and village greens. But the increase of population, the concentration of the people into towns, the rapid growth of London and the manufacturing centres, these forces conjointly waged war against the open spaces, and gradually swallowed them up. Commons disappeared, fields and lanes became

streets and houses, village greens were encroached upon or thrown into the roadways, graveyards were used as sites for railway stations and public and private buildings of all sorts, and where the dead had peacefully slumbered was heard the noisy engine and the rattling train.

But the history of the desecration and loss of the open spaces round towns is too well known for me to dwell upon it here, and many will also be acquainted with the story of their revival, for it is but a recent one. Acts of Parliament have been passed to protect and regulate commons and greens, to preserve graveyards, to promote the acquisition of open spaces in and around towns, from the largest park to the smallest playground, and to provide for their maintenance. Philanthropic societies have started into existence, whose object it has been to carry out these Acts and stir up the public bodies to do so; and now, on all sides, the public mind is awakening to its need, and the public voice is beginning to ask for its satisfaction. But although something has been done to restore the lost breathing places, much, very much, still remains to be done; and what has been accomplished in the past in a scattered and unsystematic manner, will have to be done in the future, both thoroughly and systematically.

It appears to be a generally recognised and undisputed fact that, to restore enfeebled health or weakened animation, fresh air must be resorted to, *i.e.*, air that is not contaminated by the breath of human beings. We take the fainting person out of a building, we send the consumptive patient to the top of a Swiss pass or to the sea shore, and we carry the sick child from his crowded home in the city and place him in a country village. It is only necessary to glance through those statistics which show the death-rate in the manufacturing and closely inhabited towns as compared to the death-rate in the country or the suburbs, to learn the generally well known lesson that the health of the nation suffers in proportion to the degree that the individuals are crowded. Of course, I am aware that, notwithstanding the increase of population, there is a steady decrease in the death-rate over the United Kingdom, but this is due to improved drainage, warmer clothing, the great advance in medical knowledge, and a hundred other influences which are at work among the people; and, as this is now the case, who can say how robust the nation might have been by this time if the open character of the surroundings of the towns had been preserved.

It is strange to read of the time when the youth of London needed only to go to Moorfields (where Liverpool Street Station now stands) in order to stretch their limbs and sport in the free and open country; when Oxford Street was a country road; and the way to Islington, St. Giles, or Camberwell was through pleasant, flowery fields, by rural lanes and footpaths. Now, if we live in Islington and wish to see a meadow or a hedge, we must take the train and travel in it for some miles. Certainly there are Hyde Park, Regent's Park, and some 200 smaller recreation grounds in London, besides a few open spaces on its borders, but, invaluable as they are, they cannot supply the place of the open country, nor are they really adequate to meet the wants of the vast mass of people who live round them.

Granted that fresh air and open spaces are needed for the health of the inhabitants of our larger towns, we will briefly consider the two ways of satisfying this need, namely:—1st. A systematic acquisition and preservation of land for public recreation, in connexion with the towns and in relation to their growth. 2nd. Increased facilities for taking people from the towns into the country.

In the towns themselves the governing bodies—the councils—should lay down and should carry out some such rule as the following:—That public recreation grounds should be provided in each parish, in proportion to the number of its inhabitants.

This would mean that there should be a fixed minimum of open space for a certain number of the population. Here and there the minimum would be exceeded, and so much the better for the people, but it should always be reached, either by securing existing open spaces for the public for ever, or by acquiring new ones, and this, if need be, by pulling down houses for the purpose. And for the information of those who are not well acquainted with the question of acquiring open spaces, I would mention that much may be done in the towns by securing and throwing open enclosed and deserted squares, disused graveyards, the remnants of village greens (where such have become merged into the towns), vacant plots of railway land, abandoned wharves, market-places, &c., &c. The Open Spaces Act of 1877, amended in 1881, 1887, and 1890; the Disused Burial Grounds Act of 1884, with its amendments; and other measures, give all the power that is needed to local bodies to carry out these improvements. The Metropolitan Public Gardens Association, which has been at work in London since the close of the year 1882, has laid out, or assisted to lay out, 65 gardens and playgrounds for the use of the public; has given grants of seats for 31 other sites, either streets or open spaces; has granted money towards the formation and upkeep of 23 public gymnasia; has secured the opening of 166 playgrounds belonging to the London School Board (on Saturdays); and the laying out and throwing open of 19 recreation grounds; has planted trees, and given grants for tree-planting in 37 thoroughfares and other sites; has opposed encroachments on 18 disused burial grounds, commons, and open spaces; and has in other ways assisted in the preservation and formation of very many useful recreation grounds. What has been done in London (and it is very little compared to what needs doing) can be done in the other large towns; there is the same opportunity for improving them by bringing green grass, bright flowers, and shady trees into the dingy and monotonous streets.

It may be said that if you increase suburban life you do as much harm as by enlarging a town. But, certainly, if you take the wives and children belonging to a community away from the city and into the suburbs, you are doing them good from an hygienic point of view. The husbands and fathers will have the advantage of spending their nights and their Sundays in purer air, and the disadvantage of, perhaps, journeys in a train twice or more on every week day. But London and the large towns *will* increase, and the only question to be settled is—

Are they to increase from outside inwards, or from inside outwards? These two diagrams will illustrate, in a rough manner, what I mean. The size of the central circles (denoting the towns) is the same. The size of each excrescence, and their number (denoting the suburbs), is the same. The amount of open space enclosed in each dotted circle is also the same, but its distribution is different.

In Fig. 1 the largest mass of new houses is next to the old centre, whereas the smallest group of new houses adjoins the largest plot of open space. In Fig. 2, on the contrary, a larger area of open space is brought close to the old mass of buildings, and the greatest number of new buildings are nearest to the open country. There are, perhaps, advantages in either system; but the advantages in the second, from a healthful point of view, if not from an artistic one, outbalance, in my opinion, those of the first. It may be said, however, that the plans are too fanciful to be of any use; that suburbs always grow in accordance with local need and local possibilities; and that a town built in a pattern, and only allowed to grow in a pattern, would be impossible and undesirable. But I am speaking theoretically, and I wish my theory to be illustrated in a purely systematic way. Fig. 2, if carried out, would involve a cessation of building immediately adjoining the original centre, and this is what is most needed. In other words, a town that has reached a certain size should grow no more, except from centres at a given distance outside. I am not speaking of a plan suitable for time and eternity, or to be carried out by generations far ahead of our own. They will need other and much more far-reaching reforms in building, if the population continues steadily to increase. I am speaking of something that is needed at the present time, and of a plan that might now be adopted in several of the larger towns in England. To take the metropolis as an example:—It is not so likely to hurt London that Wimbledon or Tottenham should grow to great proportions; what does hurt London is, that all the fields of Fulham and Deptford are being covered with houses. It is the increase at the centre that is so detrimental—the gradual annihilation of the remaining open space which is close to, or forms part of, the towns. The increase should be in the suburbs of a town, or, rather in a certain number of them whose centres are beyond a given distance from the city. This need not produce a monotonous sameness. There would soon be characteristic differences in the various suburban districts. There would be the aristocratic suburb, joined to the town by a handsome drive and a rotten row; the commercial suburb, with its service of city trains running every hour, half-hour, or minute, if need be; the artistic suburb, selectly free from the incursions of the railway director, where the linnet and the lily would flourish undisturbed; the domestic suburb, arranged for schools and kindergartens, nurses and perambulators; the cheap suburb, very noisy, and connected with the city by tram-lines and subways; and there might be, but we should hope that there would not be, the cheap and nasty suburb, complete in itself, in its dirt and in its degradation. But each, if not allowed to grow at the city end, but only at the end furthest removed from the town, would share alike in

possessing vast strips of open land for the recreation of the people and their children.

In the towns themselves there should be every effort made to have beautiful streets, with trees and seats in them, and beds of flowers, instead of neglected and dirty corners, and creepers planted on bare walls. Every disused graveyard and deserted enclosure should become a bright garden, and every plot of unused land be made into a children's playground or an outdoor café.

If the preservation of open spaces were properly taken in hand and systematically carried out, there would not be so much need as there is now for increasing the facilities for taking people from the towns into the country. But still it will always be of great advantage, both to young and old, to see new places and breathe different air; to visit the seaside and the rural country. The railway companies have done much of late years to render this possible to a greater number by issuing cheap "fortnightly" tickets for the sea side, &c., &c., and there is more than one useful society at work giving country holidays to city children, and sending the tired seamstress and overworked clerk to breathe the sea air; besides numberless private people who are doing their best to supply this need by throwing open their own country houses, or paying for the holidays of those who are less blest than they are with this world's goods. This is a question which is not so easily dealt with officially; it is one which, although very important, must be left more or less to be settled by the railway companies and by the people themselves. Something may be done to teach the inhabitants of the towns how best to make use of their holidays, especially the bank-holidays. But, after all, they will please themselves, and some will go to Epping Forest, while others will sit in the nearest tavern and drink, and drink, and drink; and, amongst those who are in Epping Forest, there will be some who feast their eyes on the beautiful trees and tender grass, while others will care for little beyond the ginger-beer and the sticky sweets.

It must always be remembered, in speaking of the open space question, that it is not one which, having been fully dealt with, may now be put aside as settled. On the contrary, the need of providing open spaces increases daily, while the difficulty of finding them does not diminish. It would be a great boon if a new Building Act were passed forcing builders to provide recreation grounds, or to reserve breathing spaces for a fixed number of new houses. So long as the population grows, so long will new public and domestic buildings be erected, and so long will there have to be voluntary action, if there is not State-directed action, to preserve or to provide open spaces for those who increase and multiply in the land. One word more. The work must be done well. It is better to have small recreation grounds, preserving their rural foliage and beauty, than to have large parks, stiff, flat, bare, and uninteresting. We want large and small open spaces, but natural ones; country left in the town so that the townsfolk may not forget the country.

DISCUSSION.

Mr. Rogers Field wished to suggest that all open spaces should be connected by boulevards or park roads. He was not aware that this had been done already in Chicago. He remembered that in his very early days there was an opportunity of making a magnificent boulevard between Regent's Park and Hampstead Heath. The idea had been suggested by the late Professor Cochrane in about 1851, and the plan was published in the *Builder* newspaper. The outbreak of the Crimean War had interfered with the carrying out of the plan. Then, between Primrose Hill and Hampstead Heath there was a fine avenue of trees. This avenue, which was still in existence—Belsize Avenue—could have been obtained at an exceedingly reasonable rate, and plans had been made showing how that avenue could be turned into a magnificent drive from Primrose Hill to Hampstead Heath. Now, however, unfortunately, the whole space was built over, and there was no means of connecting these two open spaces. This was a question to which the greatest attention should be paid. He happened to know the case he had cited intimately, but no doubt there were other cases round London where building was going on, and where the connexion between open spaces should be attended to.

Mr. H. H. Collins said that in this matter, as in so many others, Queen Elizabeth was right when she endeavoured to put a stop to the building of more houses in London. The builders could not be expected to help in the multiplication of open spaces, but the owners of land might be induced to do it because it could be shown to be in their own interests. They could not get the necessary means from the ratepayers, and he would rather depend upon philanthropy than upon State aid. They could not prevent landlords from selling their land, but they could be shown, as had been seen in the very district where Mr. Rogers Field lived at Fitzjohn's avenue, that an apparent sacrifice of land often increased the value of it.

Dr. J. F. J. Sykes (one of the Hon. Secretaries to the Section) said: A great deal of gratitude we owed to the ignorance—or possibly enlightenment—of those people who, by using as burial grounds large open places now in the middle of London, had kept the same from the grasp of the builder. In all probability posterity, if we took to cremation, would have no occasion to bless us from a similar point of view.

Mr. B. Johnson (of the Poplar Board of Works) thought that, in order to prevent land being so built upon that nothing could be seen of the natural beauties of a locality, power should be given to local authorities to prevent more than a certain number of houses being put upon a plot. The necessity of such restraining powers being given was well illustrated in the Isle of Dogs, where men were allowed to go down 8 ft. or 9 ft. underground with the lower floors of houses, and where many families were living literally underground. Until county councils and local authorities had such powers they would never be able to prevent land being covered by houses built like tea-chests, nor to stop jerry building.

Dr. Engel R. L. Gould, of the U.S. Department of Labour, Washington, cited statistics which showed that London held the twentieth position with regard to its open spaces, measured in terms of the number of inhabitants per acre. Vienna had a population of 473 per acre, Paris 495, Brussels 637, while London had 694. The Earl of Meath appeared to be in favour of small instead of large open spaces. He found that London took higher rank when the larger parks were left out of the reckoning. Without

the great parks, London had a population of 909 per acre; but Philadelphia, which had a population of over 1,000,000, and had only 340 per acre on the average, had 17,649 per acre when its greatest park was left out, and Vienna would have 3,300 per acre with one great park left out.

Hygienische Grundsätze für die Erweiterung und den inneren Ausbau der Städte.

VON

J. STÜBBEN, Stadtbaurath in Köln.

A.—ALLGEMEINE AUFGABE.—1. Die Erweiterung einer Stadt darf nicht der freien Privatthätigkeit allein überlassen werden, sondern ist durch amtliche Maassnahmen der Gemeinde und des Staates zu regeln; das gleiche gilt für den Ausbau einer Stadt im Innern. 2. Zu den wichtigsten Obliegenheiten, welche Gemeinde und Staat hierbei zu erfüllen haben, gehört der Schutz des gesunden Wohnens und des gesunden Aufenthalts in der Stadt.

B.—HYGIENISCHE ERFORDERNISSE. — Gesundes Wohnen und gesunder Aufenthalt erfordern: 1. Genügende Breite der Strassen; gesundheitlich zweckmässige Herstellung und Ausstattung der Strassen und freien Plätze. 2. Oeffentliche Pflanzungen. 3. Reinhaltung des Untergrundes, des Wassers und der Luft. 4. Wasserversorgungs-, Beleuchtungs- und Verkehrsanlagen. 5. Herstellung zweckmässiger Baugrundstücke in ausreichender Zahl und passender Grösse. 6. Gesundheitlich gute Anordnung und Einrichtung der Gebäude, Arbeitsstätten und Wohnungen.

C.—AMTLICHE MAASSNAHMEN. — Um diese Erfordernisse zu erreichen, sind folgende positiven und negativen Maassnahmen der Gemeinde und des Staates zu ergreifen: *a. Positive Maassnahmen.*— 1. Aufstellung eines zweckmässigen Bebauungsplanes für die Stadterweiterung, welcher sich erstreckt auf alle im Anbau begriffenen und zum Anbau in den nächsten 20 Jahren bestimmten Theile der städtischen Umgebung; Aufstellung eines zweckmässigen Bebauungsplanes für die Verbesserung der alten Stadttheile. 2. Aufstellung einheitlicher Entwürfe für Entwässerung, Abfuhr, Schutz gegen Hochwasser, Wasserversorgung, Beleuchtung und Verkehrsanlagen. 3. Ausführung der Strassen, Plätzen, und Pflanzungen, der Siele und öffentlichen Bedürfnissanstalten, des Hochwasserschutzes, der Wasserversorgungs-, Beleuchtungs- und Verkehrs-Einrichtungen *seitens der Gemeinde, insoweit Privatunternehmungen nicht ausreichen,* um einen angemessenen Vorrath an bebauungsfähigen und zur Bebauung bereit gestellten Grundstücken stets zu sichern und dadurch den Ausschreitungen des Baugrund- und Miethwuchers vorzubeugen. 4. Umlegung und Zusammenlegung der nach Lage, Gestalt und Grösse zur Bebauung ungeeigneten

DISCUSSION.

Mr. Rogers Field wished to suggest that all open spaces should be connected by boulevards or park roads. He was not aware that this had been done already in Chicago. He remembered that in his very early days there was an opportunity of making a magnificent boulevard between Regent's Park and Hampstead Heath. The idea had been suggested by the late Professor Cochrane in about 1851, and the plan was published in the *Builder* newspaper. The outbreak of the Crimean War had interfered with the carrying out of the plan. Then, between Primrose Hill and Hampstead Heath there was a fine avenue of trees. This avenue, which was still in existence—Belsize Avenue—could have been obtained at an exceedingly reasonable rate, and plans had been made showing how that avenue could be turned into a magnificent drive from Primrose Hill to Hampstead Heath. Now, however, unfortunately, the whole space was built over, and there was no means of connecting these two open spaces. This was a question to which the greatest attention should be paid. He happened to know the case he had cited intimately, but no doubt there were other cases round London where building was going on, and where the connexion between open spaces should be attended to.

Mr. H. H. Collins said that in this matter, as in so many others, Queen Elizabeth was right when she endeavoured to put a stop to the building of more houses in London. The builders could not be expected to help in the multiplication of open spaces, but the owners of land might be induced to do it because it could be shown to be in their own interests. They could not get the necessary means from the ratepayers, and he would rather depend upon philanthropy than upon State aid. They could not prevent landlords from selling their land, but they could be shown, as had been seen in the very district where Mr. Rogers Field lived at Fitzjohn's avenue, that an apparent sacrifice of land often increased the value of it.

Dr. J. F. J. Sykes (one of the Hon. Secretaries to the Section) said: A great deal of gratitude we owed to the ignorance—or possibly enlightenment—of those people who, by using as burial grounds large open places now in the middle of London, had kept the same from the grasp of the builder. In all probability posterity, if we took to cremation, would have no occasion to bless us from a similar point of view.

Mr. B. Johnson (of the Poplar Board of Works) thought that, in order to prevent land being so built upon that nothing could be seen of the natural beauties of a locality, power should be given to local authorities to prevent more than a certain number of houses being put upon a plot. The necessity of such restraining powers being given was well illustrated in the Isle of Dogs, where men were allowed to go down 8 ft. or 9 ft. underground with the lower floors of houses, and where many families were living literally underground. Until county councils and local authorities had such powers they would never be able to prevent land being covered by houses built like tea-chests, nor to stop jerry building.

Dr. Engel R. L. Gould, of the U.S. Department of Labour, Washington, cited statistics which showed that London held the twentieth position with regard to its open spaces, measured in terms of the number of inhabitants per acre. Vienna had a population of 473 per acre, Paris 495, Brussels 637, while London had 694. The Earl of Meath appeared to be in favour of small instead of large open spaces. He found that London took higher rank when the larger parks were left out of the reckoning. Without

the great parks, London had a population of 909 per acre; but Philadelphia, which had a population of over 1,000,000, and had only 340 per acre on the average, had 17,649 per acre when its greatest park was left out, and Vienna would have 3,300 per acre with one great park left out.

Hygienische Grundsätze für die Erweiterung und den inneren Ausbau der Städte.

VON

J. STÜBBEN, Stadtbaurath in Köln.

A.—ALLGEMEINE AUFGABE.—1. Die Erweiterung einer Stadt darf nicht der freien Privatthätigkeit allein überlassen werden, sondern ist durch amtliche Maassnahmen der Gemeinde und des Staates zu regeln; das gleiche gilt für den Ausbau einer Stadt im Innern. 2. Zu den wichtigsten Obliegenheiten, welche Gemeinde und Staat hierbei zu erfüllen haben, gehört der Schutz des gesunden Wohnens und des gesunden Aufenthalts in der Stadt.

B.—HYGIENISCHE ERFORDERNISSE. — Gesundes Wohnen und gesunder Aufenthalt erfordern: 1. Genügende Breite der Strassen; gesundheitlich zweckmässige Herstellung und Ausstattung der Strassen und freien Plätze. 2. Oeffentliche Pflanzungen. 3. Reinhaltung des Untergrundes, des Wassers und der Luft. 4. Wasserversorgungs-, Beleuchtungs- und Verkehrsanlagen. 5. Herstellung zweckmässiger Baugrundstücke in ausreichender Zahl und passender Grösse. 6. Gesundheitlich gute Anordnung und Einrichtung der Gebäude, Arbeitsstätten und Wohnungen.

C.—AMTLICHE MAASSNAHMEN. — Um diese Erfordernisse zu erreichen, sind folgende positiven und negativen Maassnahmen der Gemeinde und des Staates zu ergreifen: *a. Positive Maassnahmen.*— 1. Aufstellung eines zweckmässigen Bebauungsplanes für die Stadterweiterung, welcher sich erstreckt auf alle im Anbau begriffenen und zum Anbau in den nächsten 20 Jahren bestimmten Theile der städtischen Umgebung; Aufstellung eines zweckmässigen Bebauungsplanes für die Verbesserung der alten Stadttheile. 2. Aufstellung einheitlicher Entwürfe für Entwässerung, Abfuhr, Schutz gegen Hochwasser, Wasserversorgung, Beleuchtung und Verkehrsanlagen. 3. Ausführung der Strassen, Plätzen, und Pflanzungen, der Siele und öffentlichen Bedürfnissanstalten, des Hochwasserschutzes, der Wasserversorgungs-, Beleuchtungs- und Verkehrs-Einrichtungen *seitens der Gemeinde, insoweit Privatunternehmungen nicht ausreichen,* um einen angemessenen Vorrath an bebauungsfähigen und zur Bebauung bereit gestellten Grundstücken stets zu sichern und dadurch den Ausschreitungen des Baugrund- und Miethwuchers vorzubeugen. 4. Umlegung und Zusammenlegung der nach Lage, Gestalt und Grösse zur Bebauung ungeeigneten

Landparzellen in bebauungsfähige Baugrundstücke. 5. Begünstigung des Anbaues von Wohngebäuden für die unbemittelten Volksklassen. 6. Erlass gesundheitspolizeilicher Bauvorschriften für die zu errichtenden Gebäude, sowohl über die Beziehungen zwischen den Gebäuden, der Strasse und dem Grundstück, (offene Bauweise, Vorgärten Gebäudehöhe, Hofräume) als über die inneren baulichen Einrichtungen (Bauordnung). *b. Negative Maassnahmen.*—1. Verbot von Bauten, welche gegen den Bebauungsplan verstossen. 2. Verbot des Anbaues an unfertige Strassen. 3. Verbot, in bestimmten Stadttheilen gewerbliche Anstalten zu errichten, welche durch Ausdünstungen ,Rauch oder Lärm die Gesundheit der Bewohner oder die Annehmlichkeit des Wohnens beeinträchtigen. 4. Verbot des Bewohnens gesundheitsschädlicher Räume. 5. Verbot der Ueberfüllung. 6. Niederlegung gesundheitsschädlicher Gebäude und Stadttheile.

D.—Gesetzgebung.—Die Gesetzgebung des Staates ist so zu ergänzen, dass sie die Ausführung der angegebenen positiven und negativen Maassnahmen ermöglicht und erleichtert. Es bedarf insbesondere folgender Gesetze: 1. Gesetz über die Feststellung von Baufluchtlinien und Bebauungsplänen. 2. Gesetz über die Enteignung des Strassenlandes, der bebauungsunfähigen Restgrundstücke neben der Strasse, der gesundheitschädlichen Gebäude und Stadttheile (Zonen-Enteignung). 3. Gesetz über die Umlegung und Zusammenlegung städtischer Landparzellen, welche nach Lage, Gestalt und Grösse zur Bebauung ungeeignet sind. 4. Gesetz über die örtliche Beschränkung der Einrichtung lästiger Gewerbebetriebe. 5. Gesetz über das gesundheitsgemässe Bauen. 6. Gesetz über das gesundheitsgemässe Wohnen.

A. *Allgemeine Aufgabe.*—Jedes Eingreifen der staatlichen oder communalen Obrigkeit in die freie Thätigkeit des Bürgers wird von diesem unter Umständen unangenehm empfunden. Dennoch hat kein Kulturvolk, welche Regierungsform es auch besass, das Eingreifen der obrigkeitlichen Gewalt in die bürgerliche Thätigkeit entbehren können. Und bei unserer heutigen kulturellen Entwickelung ist erst recht die Unterordnung des Einzelnen unter das Allgemeinwohl von nöthen. Salus publica suprema lex.

Je mehr wir die Richtigkeit dieses Satzes anerkennen, desto wichtiger ist es auf der anderen Seite, das Eingreifen des Staates und der Gemeinde in denjenigen Dingen zu vermeiden, wo die Privatthätigkeit, ohne Missstände zu erzeugen, ausreicht. Solche Missstände aber sind durch die freie Privatthätigkeit bei der Erweiterung der Städte vielfach entstanden.

Es sind neue Strassen und Stadtviertel geschaffen worden ohne genügende Verkehrsverbindung mit der alten Stadt und mit anderen Stadtvierteln: nachträgliche Strassendurchbrüche für öffentliche Rechnung waren die Folge. Strassen ohne ausreichende Breite und mit ungeeigneten Steigungen mussten nachträglich verändert werden. Ganzen Bezirken fehlte olge unzweckmässiger Höhenanordnung die Entwässerung; Senkgruben und Schlingfelder verdarben den Untergrund, das Wasser und die Luft; die öffentliche Gesundheit litt Noth. Es ist nicht etwa bloss Mangel an gutem Willen oder an

hnischer Befähigung, wodurch die blosse Privatthätigkeit zu solchen esständen führt, sondern es liegt in höherem Grade daran, dass weder : Einzelne noch eine private Verbindung Einzelner imstande oder ufen ist, die Bedürfnisse der Allgemeinheit inbezug auf Verkehr d öffentliche Gesundheit zu überschauen, noch weniger aber die icht hat, diese Bedürfnisse unter Besiegung der entgegenstehenden ndernisse zu befriedigen. Dies gilt sowohl für die äussere Erweiterung für den inneren Ausbau einer in der Entwickelung begriffenen adt. Die Regelung und Unterstützung der Privatthätigkeit durch itliche Maassnahmen der Gemeinde und des Staates ist desshalb entbehrlich.

Thatsächlich bestehen in allen Kulturstaaten Gesetze, auf Grund ren die Gemeinde und der Staat in die Erweiterung und den Ausbau r Stadt theils positiv theils negativ eingreifen können und eingreifen. den meisten Staaten aber ist diese Gesetzgebung unvollkommen, er die Anwendung der Gesetze lässt zu wünschen übrig. Desshalb rlohnt es sich wohl, den Gegenstand auf einem internationalen ongress zu besprechen.

Unser Kongress beabsichtigt sich zwar nur mit hygienischen und mographischen Fragen zu beschäftigen. Aber eine der wichtigsten ıfgaben, welche beim Städtebau zu erfüllen sind, liegt gerade auf gienischem Gebiete: es ist der Schutz des gesunden Wohnens und s gesunden Aufenthalts in der Stadt.

Von welcher Bedeutung dieser Schutz ist, das zeigt uns der ergleich der städtischen Bevölkerungszahl mit der ländlichen und ein lick auf das rasche Anwachsen der Stadtbevölkerung.

Der Antheil der städtischen Bevölkerung, mit der wir es hier zu un haben, an der Gesammtbevölkerung betrug in den angegebenen ıhren im Deutschen Reich (1885) 43·7%, in Preussen allein (1890))·3%, in Oesterreich ohne Ungarn (1880) 38·4%, in Italien (1881))·7%, in Frankreich (1886) 36%, in England ohne Schottland und land (1871) 61·7%, in Russland ohne Finland (1885) 12·9%. Die iden zuletzt genannten Staaten zeigen die grösste und die geringste ntwickelung der Städte. Seit den angegebenen Jahren ist überall, ie vorher, die städtische Bevölkerung rascher angewachsen als die ndliche. Während z. B. die Bevölkerung Deutschlands jährlich um enig mehr als 1% zunimmt, beträgt die Volksvermehrung der meisten eutschen Städte 2 bis 4%; in kleineren Industriestädten hat man n noch schnelleres Wachsthum beobachtet. Ebenso wächst die Beohnerzahl der meisten französischen Städte jährlich um 0·5 bis 2%, owohl die Bevölkerung des ganzen Landes nur um etwa 0·15% jährlich nimmt. Ausführlichere Zahlen enthält die nachfolgende Tabelle über as jährliche Wachsthum einer Reihe von Grossstädten in den angeebenen Zeiträumen:—

JÄHRLICHE VOLKSZUNAHME EUROPÄISCHER GROSSSTÄDTE.

Deutschland.			
erlin 1880–85	- -	3·2 %	
„ 1885–90 -	-	4·0 „	
Iamburg 1880–85	-	2·0 „	
Breslau 1880–85	- -	1·9 %	
„ 1885–90	-	2·9 „	
München 1880–85 -	-	2·6 „	
Leipzig 1880–85	- -	2·7 „	

Köln 1880–85 - -	2·2 %
„ 1885–90 - -	3·5 „
Dresden 1880–85 -	2·2 „
Magdeburg 1880–85 -	3·2 „
„ 1885–90 -	5·4 „
Frankfurt a/M. 1880–85	2·4 „
„ 1885–90	3·3 „
Hannover 1880–85 -	2·6 „
„ 1885–90 -	3·3 „
Königsberg 1880–85 -	1·4 „
„ 1885–90 -	1·4 „
Oesterreich-Ungarn.	
Wien 1880–90 - -	2·0 „
Budapest 1880–90 - -	3·1 „
Frankreich.	
Paris 1872–76 - -	1·8 „
„ 1876–81 - -	3·6 „
„ 1881–86 - -	0·7 „
„ 1872–86 - -	2·0 „
Lille 1881–86 - -	1·4 „
Lyon 1881–86 - -	1·2 „
Bordeaux 1881–86 -	1·5 „
Marseille 1881–86 - -	0·8 „
Nantes 1881–86 - -	0·4 %
St. Etienne 1881–86	—0·4 „ (*Abnahme.*)
England.	
London 1861–71 -	1·5 „
Liverpool 1861–71 -	1·6 „
Manchester 1861–71 -	0·8 „
Bradford 1861–71 - -	3·1 „
Leeds 1861–71 - -	2·2 „
Sheffield 1861–71 - -	2·6 „
Holland.	
Amsterdam 1879–87 -	2·6 „
Rotterdam 1879–87 -	3·4 „
Haag 1879–87 - -	3·4 „
Schweiz.	
Zürich 1880–88 - -	2·3 „
Basel 1880–88 - -	2·1 „
Dänemark.	
Kopenhagen 1885–90 -	2·2 „
Russland.	
St. Petersburg 1881–88	—1·2 „ (*Abnahme.*)

Nur aus zwei Städten, St. Etienne und St. Petersburg, wird hiernach eine Bevölkerungsabnahme berichtet; in allen anderen übersteigt die Zunahme die Volkszunahme des Landes überhaupt. Aus England fehlen mir leider die Zahlen aus den beiden letzten Jahrzehnten. Man wird annehmen dürfen, dass von den 350 Millionen Einwohnern Europas zur Zeit mindestens 100 Millionen in Städten wohnen.

Kuichling in Rochester (N.Y.) hat durch vergleichende Untersuchung einer grossen Reihe von amerikanischen, deutschen und englischen Städten die nachfolgende mittlere Tabelle für die städtische Bevölkerungszunahme berechnet:—

Tabelle der durchschnittlichen Jahreszunahme der Bevölkerung in Prozenten.

Bevölkerungszahl.	100,000	125,000	150,000	175,000	200,000	225,000	250,000
Amerikanische Städte	4·65	4·30	4·04	3·79	3·55	3·36	3·20
Deutsche Städte -	3·57	3·33	3·10	2·87	2·66	2·46	2·26
Englische Städte -	3·16	2·99	2·83	2·67	2·52	2·38	2·26

Bevölkerungszahl.	275,000	300,000	325,000	350,000	375,000	400,000
Amerikanische Städte - -	3·04	2·92	2·80	2·70	—	—
Deutsche Städte - -	2·09	1·93	—	—	—	—
Englische Städte - - -	2·13	2·00	1·92	1·84	1·75	1·68

Die amerikanischen Städte wachsen hiernach am schnellsten, und der Prozentsatz der Vermehrung nimmt im Allgemeinen ab mit der Bewohnerzahl. Die Abweichungen von dieser Regel sind indess besonders in Deutschland zahlreich. In den sieben grössten deutschen Städten vermehrte sich die Bevölkerung während eines Jahrhunderts in Berlin um das 8fache, in Hamburg um das 5fache, in Breslau um das 5fache, in München um das 7fache, in Leipzig um das 9fache, in Köln um das 7fache, in Dresden um das 6fache.

Man denke sich, dass in einer Stadt von 100,000 Einwohnern es durch hygienische Maassnahmen gelingt, die jährliche Sterblichkeit dauernd um nur 1 auf 1,000 zu vermindern, so bedeutet dies schon die Rettung von 100 Menschenleben. Statistische Nachweisungen, dass die Sterblichkeitsziffer einer Stadt infolge einer Reihe von hygienischer Massregeln um 10 auf 1,000 gesunken ist, sind aber keine Seltenheit. Das beste Kapital jedoch, womit die Welt arbeitet, ist das Menschenleben. Daraus folgt, welche riesige volkswirthschaftliche Wohlthat wir der Menschheit zufügen, wenn wir unsere Städte, in deren Mauern jährlich allein in Europa ein Zuwachs von etwa 2 Millionen Menschen Wohnung und Erwerb sucht, so anlegen, dass von vornherein die Sterblichkeitsziffer als eine möglichst geringe sich ergiebt.

B. *Hygienische Erfordernisse.*—Die hygienischen Erfordernisse, welche zu befriedigen sind, um gesundes Wohnen und gesunden Aufenthalt in einer Stadt zu erzielen, sind mannigfacher Art. Sie beziehen sich auf die Anlage der Strassen, freien Plätze und Pflanzungen; auf die Ausstattung dieser Anlagen mit Ent- und Bewässerungs-, sowie Beleuchtungseinrichtungen; auf die Schaffung bequemer und billiger Verkehrsmittel; auf die Bereitstellung passender Baugrundstücke zur Ansiedelung, sowie auf den Erlass einer hygienisch guten Bauordnung.

Wie breit und wie gerichtet die *Strassen* sein sollen, das ist auf dem letzten hygienischen Kongress zu Wien eingehend berathen worden, wenn auch kaum mit praktisch brauchbaren Ergebnissen. So lange man die Forderung darauf beschränkt, dass das Himmelslicht in alle Wohnräume ausreichend eintreten und zu diesem Zwecke die Strassenbreite wenigstens gleich der 1½fachen Häuserhöhe sein soll, wird sie allmälig vielleicht erfüllbar werden, obwohl zur Zeit die einfache Häuserhöhe als Strassenbreite auch bei Neuanlagen noch keineswegs hat allgemein durchgeführt werden können. Wenn man aber die Forderung der Besonnung der Strassenbreite zu Grunde legt und unter dem 50sten Breitegrad Meridionalstrassen von 47^m, Aequatorialstrassen von 66^m Breite beansprucht, so verlangt man Unmögliches. Man wird in der Regel schon mit der einfachen Gebäudehöhe als Strassenbreite zufrieden sein müssen, daneben aber für eine ähnlich günstige, freie Stellung der Gebäude im Inneren der Blöcke zu sorgen haben. Als beste Strassenrichtung, insofern es sich um die Besonnung der Gebäudefronten handelt, hat *Gruber* entgegen den Ermittelungen von Vogt und Clément die zu den Himmelsrichtungen diagonalen Linien festgestellt. Dies ist um so mehr zutreffend, als mit den Häuserfronten zugleich auch alle Rück- und Seitenfronten diagonal zu liegen pflegen, während

der verhältnissmässig günstigen Ostwestlage einer Hauptfront die sehr ungünstige Nordlage der einen Seitenfront entspricht.

Bei der Stadterweiterung von Köln, welche ich die Ehre hatte zu entwerfen und auszuführen, hat, weil für die Strassenrichtungen die Lage der neuen Festungsthore zumeist bestimmend war, der hygienische Gesichtspunkt bei der Richtungswahl eine nur geringe Rolle spielen können. Dennoch ist die Diagonale zu den Haupthimmelsrichtungen vorherrschend. Die Breitenbestimmung bedurfte gewisser Uebergänge aus der sehr eng gebauten Altstadt in das neue Bebauungsfeld von 10^m auf 14^m. Letzteres ist die Minimalbreite neustädtischer Strassen; die Breite wächst von 2 zu 2^m bis auf 70^m. Die Bauordnung erlaubt leider, dass die Häuserhöhe die Strassenbreite um 3^m übersteigen darf. Die höchste zulässige Höhe beträgt 20^m.

Dass bei Feststellung des Bebauungsplanes ein angemessener Prozentsatz des Geländes für Strassen, freie Plätze und öffentliche Anlagen in Anspruch zu nehmen ist, versteht sich von selbst. Ein geringster zulässiger Prozentsatz lässt sich aber nicht, wie es oft versucht worden ist, festsetzen. Denn bei offener Villen-Bebauung mit grossen Gärten können beispielsweise 15 % Strassenflächen genügen, während bei geschlossenen fünfstöckigen Reihenhäusern, geringen Hofräumen und kleinen Blöcken 45 % Strassenflächen zu wenig sein können. Ein Durchschnittsverhältniss ist 35 %.

Zur Herstellung der Strassendämme dürfen nur Bodenarten verwendet werden, welche frei von gesundheitschädlichen Bestandtheilen sind. Vegetabilische und animalische Abfälle sind im Strassenkörper unzulässig. Dasselbe gilt für die etwaige Aufhöhung der Baugrundstücke. Vorhandene Faulstoffe sind zu entfernen, bevor man die Aufhöhung der Strassen, Plätze und Baugrundstücke beginnt. Auf Grund von Erfahrungsbeispielen vermuthe ich, dass Siechthum und Tod in mehr Fällen die Folge des schlechten Untergrundes sind, als sich nachweisen lässt.

Diejenigen Flächen der Strassen und öffentlichen Plätze, welche dem Verkehr ohne Nachtheil entzogen werden können, sind zu bepflanzen, mit Baumreihen, mit Rasen, Strauchwerk und Landschaftsgärten.

Ausser den Baumreihen auf Strassen, welche nur bei Strassenbreiten von mehr als 20^m lebensfähig sind, den Rasenbeeten und Gartenanlagen auf freien Plätzen und sehr breiten Strassen,* sind zwei Arten *öffentlicher Pflanzungen* eine hygienische Nothwendigkeit, nämlich 1. öffentliche Spielplätze für die Jugend, 2. öffentliche Gärten für die Erholung der Bürgerschaft. Spielplätze (Recreation-places) sind meines Wissens in England am meisten verbreitet: im Jahre 1889 soll London 28, Manchester 11, Birmingham 9, Bradford 7 bepflanzte Plätze dieser Art besessen haben, welche ausschliesslich dem Kinderspiel gewidmet waren. Berlin, Leipzig, Hamburg, Köln sind diesen englischen Beispielen gefolgt.

[illegible] grösseren öffentlichen Parkanlage, eines "Stadtgartens," sollte [illegible]t von 20,000 Einwohnern entbehren. Je grösser die Stadt,

Stübben, Städtebau, 5. Abschnitt, Darmstadt bei Bergsträsser, 1890.

um so geräumiger der Stadtgarten, besonders dann, wenn wenig sonstige bepflanzte Spazierwege, wie alte Wallpromenaden u. dergl., zur Verfügung stehen. Bei der Einwohnerzahl von 50,000 oder 60,000 etwa tritt der grösseren Entfernungen wegen die Nothwendigkeit des zweiten Stadtgartens ein. Grossstädte und besonders Millionenstädte bedürfen einer grösseren Zahl von öffentlichen Parkanlagen, um allen Wohnungen den Genuss des Pflanzenlebens in mässiger Entfernung zu ermöglichen. Nimmt man auf 50,000 Einwohner einen Park von 10^{ha} Grösse an, so findet sich bei einer Wohnungsdichtigkeit von 250 Personen pro Hektar das Verhältniss der Parkfläche zur Stadtfläche wie 1 : 20. Beträgt das Verhältniss der bepflanzten Strassen und freien Plätze zum Weichbilde ebenfalls 1 : 20, so erhält man als wünschenswerthe Verhältnisszahl, dass wenigstens $\frac{1}{10}$ des bebauten städtischen Weichbildes öffentlich bepflanzt sein möge.

Die englischen und französischen Städte sind, wenn auch nicht alle das angegebene Verhältniss erreichen werden, in dieser Hinsicht den deutschen und italienischen Städten überlegen. In England und Italien überwiegt die Parkanlage, in Frankreich und Deutschland die Strassenbepflanzung. Beides sollte gleichmässig gepflegt werden. In der Stadterweiterung von Köln, welche ein Gelände von 452^{ha} bedeckt, haben wir drei öffentliche Parkanlagen von zusammen 25^{ha}, gärtnerisch geschmückte freie Plätze von 8^{ha}, Gartenanlagen auf der grossen 32 bis 100^{m} breiten Ringstrasse von 8^{ha}, endlich mit Baumreihen besetzte Strassen von 12^{ha} Flächeninhalt, zusammen also 53^{ha} Pflanzungen, was $11 \cdot 7\%$ des bebauten Weichbildes beträgt.

Besonders reizvoll und hygienisch vortheilhaft sind diejenigen Parkpflanzungen, welche von den Hausgrundstücken unmittelbar zugänglich sind, wie der Parc Monceau zu Paris oder der Blasewitzer Park bei Dresden, auch diejenigen geschlossenen Squares, welche nach englischer Sitte zwar von Strassen umgeben sind, aber nur von den Umwohnern benutzt werden dürfen.

Zur Reinhaltung des Untergrundes, des Wassers und der Luft bedarf es ferner der geordneten Entwässerung, des Schutzes gegen Hochwasser, der Reinhaltung natürlicher Gewässer, der Beschränkung luftverderbender Gewerbebetriebe. Als beste Stadtentwässerung hat sich die unterirdische Kanalisation nach dem *Schwemmsystem* erwiesen, welche mangels grosser natürlicher Flüsse mit Rieselfeldern oder mechanisch-chemischer Klärung zu verbinden ist. Selbst für Köln wird seitens der Königlichen Staatsregierung eine künstliche Klärung der Kanalwässer, bevor sie in den grossen Rheinstrom münden, verlangt, eine mit gewaltigen Kosten verknüpfte Forderung, welche nach dem Stande der Wissenschaft und Pettenkofers neuesten Untersuchungen kaum gerechtfertigt erscheint.

Oeffentliche Wasserversorgung und *öffentliche Beleuchtung* sind in unseren eng bewohnten Städten, wo nicht mehr jede Haushaltung einen zuverlässigen Brunnen hat und nicht mehr Jeder auf dunkeler Strasse seine eigene Laterne tragen kann, eine Nothwendigkeit für die Gesundheit, Behaglichkeit und Sicherheit des Wohnens und des Aufenthaltes. In Köln ist der obligatorische Anschluss an die städtische

Wasserleitung für alle Wohngrundstücke eingeführt, welche nicht den Besitz eines Brunnens mit gesundem Grundwasser nachweisen.

Ebenso unentbehrlich ist die Schaffung bequemer und billiger *Verkehrsmittel*, um der gesundheitsschädlichen Wohnungs-Ueberfüllung entgegen zu wirken und auch den entfernten Wohnungen den Broderwerb im Stadtkern oder anderen Stadttheilen zu erleichtern. Diese Frage spielt wohl in allen Grossstädten; fast nirgendwo reichen die örtlichen Verkehrsanlagen aus. Die Stadt Köln plant gegenwärtig ein ganzes Netz von Schmalspurbahnen zur besseren Erschliessung der Umgebung, da die bestehenden Strassenbahnverbindungen mit den Vororten dem Bedürfniss bei weitem nicht entsprechen.

Um der *Wohnungsnoth*, diesem schlimmen Uebel aller moderner Gross- und Mittelstädte, entgegenzutreten, ist es ferner nöthig, die Erweiterung und den Ausbau der Stadt so zu entwerfen und *auszuführen*, dass ein angemessener Vorrath zweckmässiger Baugrundstücke in passender Grösse stets vorhanden sei. Die Blockgrösse kann nicht schematisch festgestellt werden, sondern hat sich nach der zweckmässigen Bauart der zukünftigen Baulichkeiten zu richten: kleine Blöcke für Arbeiterwohnungen, mässige Blöcke für bessere Wohnungen und Geschäftsviertel, grosse Blöcke für Gewerbebetriebe. Für Häuser mit Stockwerkwohnungen (Zinshäuser, appartment-houses, flats) sind Blöcke von bescheidenen Tiefen zu empfehlen, damit nicht das Streben nach thunlichster Ausnutzung des Bodens zur Errichtung grosser Hinter- und Quergebäude führe. Bei Blöcken für offene Bebauung mit Villen, besonders mit Einfamilienhäusern, sind grössere Abmessungen zweckdienlich, um geräumige Gärten zu ermöglichen. In der Kölner Stadterweiterung schwankt hiernach die Blockgrösse zwischen 2,200 und 48,000^{qm} bei 36 bis 130^{m} Tiefe.

Die gesundheitlich gute Anordnung und Einrichtung der Gebäude, Arbeitsstätten und Wohnungen ist die Aufgabe der Bauherren und Baumeister. Die Erfüllung dieser Aufgabe ist unentbehrlich, damit nicht die öffentliche Fürsorge hinsichtlich der Strassen und Plätze, der Pflanzungen und der Kanalisation, der Wasserversorgung und Beleuchtung, der Verkehrseinrichtungen und der Baugrundstücke in ihrem Erfolge vereitelt werten.

C. *a. Amtliche Maassnahmen positiver Art.*—Um die erörterten hygienischen Erfordernisse zu erreichen, sind zahlreiche theils positiv, theils negativ wirkende Maassnahmen seitens des Staates und der Gemeinde zu ergreifen und durchzuführen.

Dahin gehört in erster Linie die Aufstellung eines umfassenden, zweckmässigen Bebauungsplanes für die Stadterweiterung, welcher sich erstreckt auf alle im Anbau bereits begriffenen und zum Anbau in den nächsten zwanzig Jahren voraussichtlich bestimmten Theile der städtischen Umgebung, und damit im Zusammenhange die Aufstellung eines zweckmässigen Bebauungsplanes für die Verbesserung der alten Stadttheile. Wenn wir den Bebauungsplan auf eine 20jährige Entwickelungszeit bemessen wollen, so ist das selbstredend nur annähernd zu verstehen. Ein Plan für eine wesentlich kürzere Frist unterliegt der Gefahr, schon nach wenigen Jahren sich als unzureichend zu erweisen, da der Anbau nicht geschlossen, sondern mit Lücken zu

erfolgen pflegt. Ein für eine wesentlich längere Frist bestimmter Erweiterungsplan läuft Gefahr, einer Entwickelung nachtheilig vorzugreifen, deren Vorbedingungen sich noch nicht erkennen lassen Die räumliche Ausdehnung des Erweiterungsplanes ist ferner abhängig von dem zu erwartenden Bevölkerungszuwachs. Ein Jahreszuwachs. von 2°/₀, 3°/₀, 4°/₀ bedingt in 20 Jahren bei gleichbleibender Wohndichtigkeit eine Vergrösserung des bebauten Weichbildes um 48, 80, 119°/₀. Zur Anstrebung verminderter Wohndichtigkeit ist eine noch grössere Ausdehnung des Bebauungsfeldes erforderlich. Der Fortschritt der Entwickelung bedingt ein entsprechendes beständiges Fortschreiten der Planfeststellung.

Die gleichzeitige Planfestsetzung für die Verbesserung der alten Stadttheile aus Gründen des Verkehrs oder der öffentlichen Gesundheit wird in den meisten Städten zu wenig systematisch betrieben. Eine bloss gelegentliche Thätigkeit genügt auf diesem Gebiete nicht, sondern die Beseitigung vorhandener Missstände und die Berücksichtigung der Rückwirkung der Neuanlagen auf die Altstadt bedarf einer andauernden, planmässigen Aufmerksamkeit.

Zum Theil mit der Bearbeitung der Bebauungspläne im Zusammenhange, zum Theil selbständig nebenher sind einheitliche Entwürfe für Entwässerung, Abfuhr, Hochwasserschutz, Wasserversorgung und Beleuchtung aufzustellen und beständig, nicht dem Bedürfnisse folgend, sondern demselben voranschreitend, zu erweitern. Die Entwässerungsfähigkeit des Baugeländes ist eine der wichtigsten hygienischen Forderungen; sehr beträchtliche Strassen-Aufhöhungen, bis 5 ja 7ᵐ, sind für diesen Zweck gerechtfertigt. Jedenfalls sollen alle Wohnräume und womöglich auch die Keller dem Einflusse des Hochwassers eines Flusses oder des Grundwassers entzogen werden. Der sichere Anschluss aller Keller an das unterirdische Kanalnetz ist dringend erwünscht.

Die Entwürfe für Verkehrsanlagen und deren Ausführung sollen ebenfalls dem Bedürfnisse nicht nachfolgen, sondern ihm vorauseilen. Strassenbahnen, Stadteisenbahnen und Vorortbahnen erleichtern oder ermöglichen erst eine zerstreutere Bebauung, eine gesunde Ausbreitung der städtischen Bevölkerung. Nur im geringen Umfange haben bisher die Gemeinden selbst die Errichtung und den Betrieb von Verkehrsanlagen in die Hand genommen. Täuschen wir uns nicht, so bereitet sich auf diesem Gebiete ein Umschwung im Sinne des stärkeren Eingreifens der communalen Thätigkeit vor. Aber auch auf Privatunternehmungen können die Gemeinden fördernd einwirken durch geeignete Bedingungen bei Gewährung und Verlängerung lukrativer Concessionen, durch Zinsbürgschaften und ähnliche Mittel.

Es genügt nicht, dass die Gemeinde bloss als Polizei- und Aufsichtsbehörde den Privatunternehmungen zuschaut. Besonders die ausgiebige Anlage neuer Strassen mit allen dazu gehörigen Veranstaltungen ist eine hochwichtige Aufgabe der Gemeinde, sowohl um die Gemeindeländereien der Bebauung zu erschliessen, als um die Privatländereien in Anbaugrundstücke umzuwandeln, letzteres insoweit als die Privatthätigkeit nicht ausreicht, um einen angemessenen Vorrath

an bebauungsfähigen und zur Bebauung bereit gestellten Grundstücken stets zu sichern.

Denn gegen die der Städte-Erweiterung, d. h. der Vermehrung der Wohnungen, so sehr nachtheilige Preistreiberei der Grundstücke giebt es kein wirksameres Mittel als die *Vermehrung des Angebotes.* Die Vermehrung der Wohnungen ist aber Vorbedingung für alle Maassregeln zur Milderung der Wohnungsnoth, zur Beseitigung der Wohnungs-Ueberfüllung, zur Verbesserung oder Schliessung oder Vernichtung gesundheitlich schlechter Wohnungen. Als beispielsweise die Stadt Köln vor einigen Jahren in der Lage war, eine Fülle fertiger Baugrundstücke zu mässigen Preisen an den Markt zu bringen, war eine unwiderstehliche Einwirkung auf die engen, schlechten Wohnungen der Altstadt zu beobachten, welche in grosser Zahl theils verbessert, theils niedergelegt und durch bessere Wohnungen ersetzt wurden, zum Vortheil nicht bloss der Miether, sondern auch sehr vieler Eigenthümer.

Zur Bereitstellung vieler neuer Baugrundstücke genügt aber nicht die Anlage der Strassen und ihres Zubehörs an Pflanzungen, Verkehrseinrichtungen und unterirdischen Werken. Es muss hinzutreten die freiwillige oder zwangsweise vorzunehmende *Umlegung und Zusammenlegung* der nach Lage, Gestalt und Grösse zur Bebauung ungeeigneten Landparzellen in Baugrundstücke, welche den festgestellten und ausgeführten Strassenzügen entsprechen. Aus manchen Gründen ist es bekanntlich nicht möglich und nicht zweckmässig, das städtische Strassennetz nach den zufälligen Begrenzungen der vorhandenen Landparzellen zu richten. Die Strassen schneiden die Grundstücksgrenzen meist unter spitzen Winkeln, manche Grundstücke kommen gar nicht an eine Strasse zu liegen, von andern bleiben nur unförmliche Reste zu beiden Seiten der Strasse übrig. Die Landparzellen sind oft sehr schmal und von grosser Länge, so dass sie weder in der Längenrichtung noch in der Breitenrichtung zur Bebauung sich eignen. Der seitherigen Parzellirung aus landwirthschaftlichen Rücksichten, der seitherigen Zerlegung des Besitzes durch Kauf und Erbtheilung liegen die Rücksichten auf die nunmehrige Bestimmung zur städtischen Bebauung nicht zu Grunde, weil die Linien des städtischen Strassennetzes nicht vorherzusehen waren, auch der Einfluss des Einzelnen sich auf sein Eigenthum beschränkt. Die Umlegung des Besitzes nach Maassgabe der neuen Anbaustrassen erfordert aber naturgemäss die Mitwirkung mehrerer Eigenthümer, gewöhnlich sogar aller Eigenthümer eines von Strassen umgrenzten Blocks. Ein einziger Eigenthümer kann oft die Regelung des ganzen Blocks verhindern, sei es aus Eigensinn, sei es aus berechnetem Eigennutz. Die Kölner Stadterweiterung ist leider reich an solchen Beispielen menschlichen Uebelwollens, und ganze Blockgruppen können heute noch nicht der Bebauung erschlossen werden, weil einzelne Besitzer der Grenzregelung dauernd widerstreiten. Zuweilen gelingt es, alle Betheiligten nach längeren Verhandlungen auf einen Umlegungsplan zu vereinigen: der Vorwärtsstrebende muss dabei dem Zurückhaltenden Opfer bringen. Oft aber ist jede Mühe umsonst; und wenn schliesslich das Verkehrsbedürfniss die Ausführung des

Strassenbaues gebieterisch verlangt, so werden die missgestalteten, schiefen, ineinander geschachtelten, einander schädigenden Grundstücke alsdann ohne vorherige Regelung bebaut, zum grossen wirthschaftlichen Nachtheil der zeitigen Eigenthümer, aber zum noch grösseren, dauernden, wirthschaftlichen und gesundheitlichen Nachtheil der zukünftigen Bewohner-Generationen.

Daraus folgt die Nothwendigkeit des gesetzlichen Eingreifens behufs Umlegung und Zusammenlegung städtischer Baugrundstücke, falls die freiwilligen Bemühungen nicht zum Ziele führen. In einzelnen Staaten, z. B. im Grossherzogthum Hessen, giebt es ein solches Gesetz; in den meisten Ländern bildet das Fehlen desselben eine grosse Erschwerniss des Städtebaues, auch in hygienischer Beziehung.

Der Schwerpunkt der Wohnungsfrage liegt in der Verbesserung der alten und in der Beschaffung zahlreicher neuer Wohnungen für die unbemittelten Volksklassen. *Der Neubau von Wohngebäuden letzterer Art ist daher seitens des Staates und seitens der Gemeinde zu begünstigen.* Selbst Wohnhäuser für Unbemittelte zu errichten, ist nicht die Aufgabe der Gemeinde oder des Staates; von dieser Bethätigung des Sozialismus sind wir hoffentlich noch recht weit entfernt. Das ist Sache der Gewerbetreibenden, der Kapitalisten, der Arbeitgeber, gemeinnütziger Vereine und genossenschaftlicher Unternehmungen. Aber Staat und Gemeinde können diese private Thätigkeit wirksam unterstützen durch die Anlage von Strassen und Bereitstellung von Baugründen in der vorbesprochenen Weise, durch zweckdienliche Eintheilung des Strassenplanes, durch öffentliche Pflanzungen, durch Ermässigung oder Erlass von Immobilarsteuern und Strassenbau-Abgaben, durch billige Lieferung des Wassers u. s. w. Nur an wenigen Orten hat bisher eine derartige fördernde Mitwirkung der öffentlichen Gewalten zur Lösung der Wohnungsfrage, welche vielleicht als die bedeutsamste aller hygienischen Tagesfragen bezeichnet werden darf, in systematischer Weise stattgefunden. Zwar entspricht der Mehrbedarf an Wohnungen nicht immer der Zunahme der Bevölkernng; bei steigendem Wohlstand überwiegt der Wohnungsbedarf, in Zeiten schlechten Geschäftsganges bleibt der Wohnungsbedarf zurück, weil Viele sich einschränken. Aber im Allgemeinen ist der Bedarf besonders an kleinen Wohnungen stets ein grosser, und es ist eine Thatsache, dass die Spekulation aus sich diesen Bedarf an kleinen Wohnungen nicht zu erfüllen pflegt.

Gesundheitspolizeiliche Bauvorschriften für alle zu errichtenden Gebäude sind gegenüber dem Bestreben des Grundbesitzers, die Rente seines Grundstücks durch möglichst dichte und möglichst hohe Bebauung zu steigern, unentbehrlich. Zur Regelung der Beziehungen zwischen den Gebäuden, der Strasse und dem Grundstück bedarf es der Vorschriften über die Abstände der Gebäude von einander und von der Strasse, sowie über die Höhe der Gebäude an den Strassen und an den Höfen und über die Grösse der letzteren.

Was die Gebäudeabstände betrifft, so ist die gesundheitlich beste Anordung des Wohnhauses offenbar die Freistellung ringsum. Zu erreichen ist das nur durch die sogenannte *offene Bauweise*, auch Villenbau oder Cottagesystem benannt. Allgemein ist eine solche

Bauweise aber undurchführbar. Sowohl im Inneren der Städte als auch in äusseren Geschäftsstrassen ist der geschlossene Reihenbau aus wirthschaftlichen und gewerblichen Gründen nothwendig; die offene Bauweise muss daher auf bestimmte Stadttheile beschränkt werden, wo sie aber strenge durchgeführt werden sollte. Sie ist eine hygienische Wohlthat nicht bloss für die Bewohner des einzelnen Hauses, sondern mehr noch wegen der freien Durchfluthung der Strassen und Blöcke von Luft und Licht für das ganze Stadtviertel und dessen Umgebung und alle dort Wohnenden und Verkehrenden.

An manchen Strassen, wo die pflichtmässige offene Bauweise nicht erreichbar ist, führt die gesetzliche Anordnung von *Vorgärten* zwischen der Strasse und den Häusern wenigstens einen Theil der vorerwähnten hygienischen Vorzüge herbei.

Die Höhe der Gebäude in Bezug auf die Strassenbreite habe ich bereits erwähnt. Schwieriger und, da die meisten Wohnräume einer Stadt nicht an den Strassen, sondern an den Höfen zu liegen pflegen, noch wichtiger ist die Beschränkung der Gebäudehöhe an den Höfen. Der "Entwurf reichsgesetzlicher Vorschriften zum Schutze des gesunden Wohnens," aufgestellt im Jahre 1889 vom Deutschen Verein für öffentliche Gesundheitspflege, lässt an den Höfen eine Gebäudehöhe zu, welche das Anderthalbfache des mittleren Abstandes von der gegenüberliegenden Begrenzung des unbebauten Raumes beträgt. Einen hygienischen Grund, an den Höfen ein ungünstigeres Verhältniss zwischen Höhe und unbebauter Breite zuzulassen, als an der Strasse, giebt es nicht. Der Entwurf des deutschen Vereins trägt also schon, dem Zwang der Umstände folgend, der herrschenden engen Bauweise, welche nicht mit einem Schlage beseitigt werden kann, gebührend Rechnung. Der auf dem internationalen Kongress in Wien von Trélat gemachte Vorschlag, die oberen Stockwerke der hohen Gebäude zu enteignen und niederzulegen, würde zwar das Uebel beseitigen; aber kein Staat und keine Gemeinde vermag die Geldmittel aufzubringen, welche zur Ausführung einer solchen Enteignung erforderlich sein würden. Die in vielen Bauordnungen enthaltenen Bestimmungen, dass ein aliquoter Theil des Grundstücks, etwa $\frac{1}{3}$ oder $\frac{1}{4}$, unbebaut bleiben müsse, fällt nicht mit dem hygienischen Interesse zusammen, da für letzteres das günstige Verhältniss der Hofräume zur Gebäudehöhe, nicht das Verhältniss der Hofräume zur Grundstücksgrösse maassgebend ist. Die von einigen Schriftstellern empfohlene Festsetzung rückwärtiger Baufluchtlinien, welche die Gebäudetiefen beschränken, also das Innere des Blocks von der Bebauung frei halten sollen, halte ich nur in Ausnahmefällen für durchführbar.

Bezüglich der inneren Gebäude-Einrichtungen sind Vorschriften erforderlich über die geringste Höhe der Wohnräume (2·5 oder 3^{m}), ber die geringste Lichtfläche der Fenster ($\frac{1}{10}$ oder $\frac{1}{12}$ der Zimmerfläche), grösste Zahl der über einander liegenden Wohngeschosse (4 oder 5) über hochwasserfreie und grundwasserfreie Lage der Wohnräume, über den Schutz gegen aufsteigende Feuchtigkeit, über die Beschaffenheit von Wohnräumen im Kellergeschoss, über Zahl und Beschaffenheit der Aborte, der Entwässerungs- und Leuchtgas-Leitungen. Ich muss mich hier damit begnügen, auf den oben erwähnten "Entwurf

reichsgesetzlicher Vorschriften," sowie auf die Schriften über Hausentwässerung von W. P. Gerhard in New-York hinzuweisen.

b. Amtliche Maassnahmen negativer Art.—Gesetzliche oder polizeiliche Verbote auf dem Gebiete der Wohnungsfrage sind erst dann zulässig und können auch erst dann wirksam sein, wenn durch die vorbeschriebenen positiven Maassnahmen die Entstehung gesunder und zweckmässiger Wohnungen in ausreichender Zahl herbeigeführt oder gesichert ist.

Die ersten beiden Verbote betreffen alsdann die Herstellung von Bauten, welche gegen den veröffentlichten Stadtbauplan verstossen, sowie solcher Bauten, welche an unfertige Strassen errichtet werden sollen, d. h. an Strassen, in welchen für den Fahr- und Gehverkehr, für Wasserzuführung und Wasserabführung und für die Beleuchtung noch nicht ausreichend oder noch gar nicht gesorgt ist. Das erstere Verbot besteht in allen Kulturstaaten mit wenigen Ausnahmen, das zweite Verbot dagegen ist noch keineswegs allgemein verbreitet. In Preussen ist den Gemeinden das Recht verliehen, das Bauen an unfertige Strassen durch Ortsstatut zu verbieten. Aber über eine bloss finanzbüreaukratische Handhabung dieses Verbotes, dem doch die systematische Fertigstellung einer ausreichenden Zahl von Strassen für den Anbau gegenüberstehen müsste, haben sich leider im Allgemeinen die preussischen Städte nicht erhoben. Das Verbot wird nämlich in der Regel nur ausgesprochen, wenn der Baulustige den für seinen Fall von der Gemeinde geforderten Beitrag zu den Herstellungskosten der Strasse zu zahlen ablehnt. Im Uebrigen pflegt man das Bauen auch an unfertigen Strassen fast regelmässig zu gestatten, für die Fertigstellung der Strassen aber nicht dem Baubedürfnisse wie es sein müsste voraufgehend, sondern nur dem Baubedürfnisse sehr langsam folgend, Sorge zu tragen. Diese den Bau von Wohnungen mehr erschwerende als fördernde Gemeindepolitik ist hygienisch durchaus nicht zu billigen.

Ein drittes Verbot bezweckt, die Freihaltung gewisser Stadtviertel, namentlich solcher, welche für offene Bauweise bestimmt, welche wegen gärtnerischer Anlagen oder sonstiger öffentlicher Pflanzungen besonders für ruhiges Wohnen aufgesucht werden, welche Kranken- oder Genesungsanstalten enthalten, von lästigen Gewerbebetrieben. Ausdünstungen, Rauch und Lärm können die Gesundheit und Annehmlichkeit des Wohnens erfahrungsgemäss ernstlich gefährden und manche hygienischen Maassregeln unwirksam machen. Ein örtlich beschränkendes Verbot derartiger gewerblicher Anstalten ist desshalb gerechtfertigt, namentlich, wenn für gute gewerbliche Vorbedingungen in anderen Stadttheilen seitens der Behörden gesorgt wird.

Das Verbot des Bewohnens gesundheitsschädlicher Räume, sowie das Verbot der Wohnungs-Ueberfüllung und die Niederlegung derjenigen gesundheitsschädlichen Gebäude und Gebäudegruppen, welche nur durch völligen Neubau zu saniren sind, dies sind hygienische Nothwendigkeiten, da die schlechten und überfüllten Wohnungen nicht allein für die Bewohner unmittelbar, sondern durch Ansteckung und Entsittlichung auch für die Allgemeinheit verderblich werden. Der Neubau gesunder Wohnungen und *die Verbesserung schlechter*, aber noch gebrauchsfähiger Wohngebäude muss natürlich mit diesen Verboten

Hand in Hand gehen. Ob die schädliche Ueberfüllung schon vorhanden ist, wenn eine Familie weniger als 20^{cbm} Wohnraum pro Kopf besitzt, oder ob das Vorhandensein eines Schlafraumes von 10^{cbm} pro Kopf genügt, das lässt sich schwerlich auf blossem wissenschaftlichen Wege feststellen. Man wird mit dem wirthschaftlich Erreichbaren sich begnügen und eine *allmälige* Gesundung der durch örtliche Enquêten festzustellenden Wohnungsverhältnisse anstreben müssen.

D. *Gesetzgebung.* — Die geschilderten positiven und negativen Maassregeln der Gemeinde und des Staats sind nur ausführbar auf Grund einer entsprechenden Gesetzgebung. Sechs Gesetze sind es hauptsächlich, welche sich nach den bisherigen Erfahrungen und nach den Berathungen der hygienischen Vereine als nothwendig erwiesen haben.

Zunächst ein Gesetz über die Feststellung von Baufluchtlinien und Bebauungsplänen. Das preussische und mehr noch das hessische Gesetz über diesen Gegenstand entsprechen ziemlich, wenn auch nicht vollkommen, den gesundheitlichen Anforderungen. In manchen Staaten ist dieser Zweig der Gesetzgebung noch wenig ausgebildet, in anderen herrscht noch Unklarheit und Willkür.

Das Enteignungsgesetz ist gleichfalls in den meisten Staaten noch unvollkommen. So kann man z. B. in Preussen zwar das zukünftige Strassenland enteignen, nicht aber die bebauungsunfähigen Restgrundstücke neben der Strasse (welche in der Hand eigennütziger Besitzer den Anbau behindern oder verschlechtern) und ebensowenig solche Gebäude und Gebäudegruppen, deren Beseitigung im Interesse der öffentlichen Gesundheit gefördert werden muss. Frankreich und England sind auf diesem Gebiete erfreulich vorgeschritten, wenngleich sowohl die bezügliche französische Gesetzgebung als die englischen Torrens- und Cross-Acts der weiteren Entwickelung und namentlich der wirksameren Handhabung bedürfen.

Ebenso nothwendig ist ein Gesetz über die oben besprochene, baufähige Umlegung und Zusammenlegung unbebauter städtischer Grundstücke, sowie ein Gesetz, welches die Ausschliessung lästiger Fabrikanlagen aus reinen Wohnvierteln ermöglicht.

Von entscheidender Wichtigkeit aber sind hygienisch durchdachte Gesetze über das Bauen und über das Wohnen. Baugesetze besitzen wohl alle Kulturstaaten; aber nöthig ist deren Durchsicht vom Standpunkte der öffentlichen Gesundheitspflege und die allgemeine Festsetzung der als Mindestforderung zu beobachtenden hygienischen Vorschriften, deren Durchbildung und Verschärfung nach örtlichem Bedürfniss und wirthschaftlicher Erreichbarkeit die Pflicht der einzelnen Gemeinden ist.

Eine hygienische *Wohnungs-Gesetzgebung* steht gegenwärtig in Deutschland, in Oesterreich, in England, in Frankreich, in Italien auf der Tagesordnung. Die Frage wird nicht verschwinden, bis sie gelöst ist. Sie ist ein wichtiger Zweig der allgemeinen sozialen Frage. Allgemeine gesetzliche Vorschriften über die Vermiethung und die Benutzung der Wohnungen, gegen die Ueberfüllung und Verwahrlosung derselben, sind überall als ein Bedürfniss der Gegenwart erkannt.

Es würde zu weit führen, hier des Näheren auf diesen wichtigen Gegenstand einzugehen. Der Zweck dieses Vortrags ist erfüllt, wenn es mir gelungen ist, die *allgemeine Aufgabe*, welche uns bei der Erweiterung und dem inneren Ausbau der Städte gestellt ist, die *hygienischen Erfordernisse*, welche Vorbedingung sind für das gesunde Wohnen und den gesunden Aufenthalt in unseren Städten, sowie die *amtlichen Maassnahmen* positiver und negativer Art, welche zur Befriedigung jener Erfordnernisse geeignet sind, annähernd darzulegen und schliesslich die Hauptpunkte anzugeben, über welche die *hygienische Gesetzgebung* im städtischen Bau- und Wohnungswesen sich zu erstrecken hat. Every man may do his duty!

DISCUSSION.

Mr. John Slater said that so large a subject could not be disposed of in fifteen minutes. There was matter sufficient for the whole sitting, and even for an adjourned discussion. The great difficulty in London was its enormous size. The distances in continental cities were as nothing to those in London. Nearly all the continental cities, too, had been fortified, and the disused fortifications could be best utilised now by turning them into boulevards and open spaces. Herr Stübben had rendered good service by advocating a regulation to restrict the height of buildings in narrow thoroughfares. Even we in London moved far too slowly in this respect. Herr Stübben was entitled to our warmest thanks for coming here to tell us what was being done abroad for the extension and internal improvement of towns.

Mr. Rogers Field said that byelaws for the regulation of buildings and drainage had been of the greatest utility, but he very much questioned whether the regulations relating to houses were scientific. In the little town of Uppingham he had seen a good deal of the working of such regulations from the beginning, and he found quite as much indirect advantage from them in the education of the public mind on sanitary questions as of direct advantage. It was often urged that byelaws might be serviceable for new buildings, but how about the old ones? The answer suggested by his experience was, that if once the principle were adopted by the people generally, it would be applied by them to old buildings as well as to new. If people saw it was to their advantage they would make the regulations apply to both.

Mr. Thomas Blashill, Superintending Architect to the London County Council, regretted the tendency to consider the question as too large a one to be effectively dealt with. It was considered by many people not possible to make an old town perfectly habitable. The question had been taken up by faddists and inexperienced persons, which accounted for their failure to find the solution. If approached in a scientific spirit, and backed by sufficient funds, there was no reason to despair of a practical solution of the problem being found.

Herr Ludwig Techner (Budapest) sagte,—die Gesetze und Regeln die uns Herr Stübben empfiehlt und die er selbst in Köln so glänzend zur Geltung gebracht hat, sind wohl die richtigen, doch lassen sich diese nicht so leicht überall gleichmässig anwenden, und zwar sind wohl Klima, Gewohnheiten und bestehende Verhältnisse von grossem Einfluss auf die Möglichkeit der Durchführung. So können diese in Stadttheilen,

welche oft auch historische Bedeutung haben, schwer durchgeführt werden, und sind hierzu meistens gewisse Vorwaltensregeln erforderlich, die sehr häufig den Widerstand der Bevölkerung herausfordern und mit ungewöhnlichen finanziellen Opfern verbunden sind. Die schädliche Ueberspeculation mit Bau-Gründen und Hinauftreibung der Reichen kann wohl durch grösseres Angebot ermässigt werden, doch ist dies mit dem Nachtheil verbunden, das Strassen und Strassen-Einrichtungen für grosse Complexe im Voraus hergestellt, auch erhalten werden müssen, bevor die Verbannung erfolgt, und dies vertheuert die empfohlene Methode. Wo möglich sind solche Umänderungen und Erweiterungen populär zu machen, und Eingriffe privatrechtlicher Natur nicht zu forciren, wo diese nicht unbedingt nothwendig sind. Bei Anlagen von Baumpflanzungen ist wohl auch das Klima massgebend, Rasenflächen im südlichen Klima nur mit grossen Kosten schön zu erhalten. Wo also Verhältnisse und Umstände es erlauben, sind die empfohlenen Regeln anzuempfehlen und werden gewiss zu sehr günstigen Resultaten führen.

Hygiène des Groupes d'Habitations à Bon Marché.

PAR

M. Charles Lucas, Architecte à Paris, &c.

Les efforts tentés actuellement pour réunir, aux abords d'une grande exploitation ou dans certains quartiers d'une ville industrielle, des habitations de divers genres, telles que des maisons à étages comprenant quelquefois des chambres garnies ou non mais toujours plusieurs logements par étages, et des petites maisons, isolées ou groupées, mais affectées chacune à une ou deux familles au plus, entraînent, outre l'étude générale des données de l'hygiène propres à chacun de ces modes d'habitation, une étude particulière des données de l'hygiène spéciales à l'ensemble de ces habitations et à leur groupement.

Cette hygiène, à la fois publique et privée, morale même, qui, le plus, ne doit pas être étrangère à toute préoccupation d'assurer un certain charme pittoresque à l'ensemble des habitations à créer non plus qu'à toute économie réalisable par suite du groupement de ces habitations, se rapporte à la fois aux deux grandes divisions :—I. *Création et agrandissement des Villes ; et II. Construction*, en même temps que à divers alinéas du programme de la Section VI. ; car, pour ces groupes d'habitations à bon marché, il y aura à se préoccuper, à une échelle restreinte, il est vrai, des espaces libres à réserver (A) et des rues intérieures (B) ; toutes les conditions d'une bonne construction devront y être soigneusement recherchées ; de plus, ces groupes participeront à la fois des habitations particulières (C) et des habitations communes (D) ; enfin, si, comme il est désirable de le voir réaliser, des locaux industriels (E) et quelques bâtiments publics (F), locaux et bâtiments réservés à l'usage seul des habitans des groupes ainsi créés, viennent

faire de ces ensembles d'habitations à bon marché comme un quartier dans une ville, aucune des préoccupations qui ont si judicieusement inspiré les auteurs du programme de la section VI. (Architecture appliquée à l'hygiène) ne devra rester étrangère à cette étude.

C'est donc une vue d'ensemble des nombreux points que soulève l'hygiène du groupement des divers genres d'habitations à bon marché que l'auteur se propose d'exposer, vue d'ensemble dont il s'efforcera de préciser les données multiples par des exemples pris sur des types existants.

DISCUSSION.

Mr. Wm. White said the question of rent must always depend on the value of land, and whatever could be done to get land at a lower price should be within the question.

Mr. H. H. Statham referred to a point not hitherto touched upon, the spacing between blocks of dwellings. The building of high blocks in order to make the most of the value of the ground, unless the buildings were spaced proportionally farther apart, was just as much overcrowding as cramming people together in lower buildings in narrow streets. Moreover, the high buildings, unless far enough apart, shut out the sunlight from each other. Light was most important, and in some collections of blocks in London this consideration has been flagrantly neglected.

The Control of the Construction of Dwelling-houses.

BY

THOMAS BLASHILL, F.R.I.B.A., Superintending Architect to the London County Council.

The right and the duty of the public authority to make and to enforce regulations for the construction of habitable buildings, with proper regard to their healthy occupation, have been recognised in this country by many special Acts of Parliament affecting the metropolis and our larger towns, and also by the Public Health Act, which is applicable wherever the density of a population renders such regulations necessary. The laws of other countries generally recognise the same right and duty.

The chief structural conditions of a habitable building which are recognised as being necessary for its healthy occupation are these :—

1. It must stand upon a site the subsoil of which is naturally dry, or is properly drained and free from impurity; and effective means must be taken to prevent the admission of air from the soil into the building.

2. The building materials—particularly the bricks, the mortar, and the plaster of the walls—must be of good quality, so that neither moisture nor impure air can be admitted through them into the building, and means must be taken to prevent the moisture from the ground rising up the walls.
3. All parts of the building, and not merely those parts which are actually inhabited, must be properly ventilated and lighted, the habitable rooms being of sufficient size and particularly of sufficient height.
4. Provision must be made for the removal of refuse, whether solid or liquid, from the building, and from its near neighbourhood, before this refuse begins to pollute the air.

In order to show how these matters may be dealt with by law, I will, in the first place, give the regulations which are now in force in London and applicable to each of these necessary structural conditions.

The Metropolitan Buildings Act and the Metropolis Local Management Act were passed in 1855, and have been since amended by several Acts, some of which give to the London County Council a limited power of making byelaws. So far as these Acts and byelaws relate to buildings, they are chiefly intended to provide for the sound construction of walls and the prevention of fires. The regulations that relate to health as affected by construction are few and not very efficient for their purpose.

As regards the sites of buildings, the byelaws made under the Amendment Act of 1878 require that they shall be cleared of any material impregnated or mixed with fæcal, animal, or vegetable matter, dust, or slop, or other refuse with which they have been filled up or covered, and the holes thus formed must be filled up with "hard brick or dry rubbish." The Amendment Act of 1890 empowers the council to make byelaws regulating the mode in which any excavation made within 3 feet of a building shall be filled up. The object is to clear the site from impurity, but when I say that the existing byelaws were found insufficient to prevent the erection of houses upon a disused cemetery filled up by interments, some idea may be formed of the difficulties that beset the makers of regulations for sanitary purposes. Under the Public Health Act, 1875, certain byelaws have been framed by the Local Government Board applicable to the cases of urban and rural sanitary authorities, and these are now generally adopted outside the metropolis, with or without modifications sanctioned by that Board. The new byelaws of the city of Manchester, approved in 1890, probably give their best and most modern form. They require, in addition to the removal of any impure material from the site, the removal of any such matter as may have been deposited upon the site, but they are silent as to the filling up of any holes left by the excavation.

The Metropolitan Regulations make no provision for the drainage of a site that is naturally damp. The Model Byelaws provide that the subsoil shall be drained with earthenware field pipes, which shall be trapped and ventilated at their junction with the foul drain of the house. In a district where much of the subsoil had been excavated for the

removal of clay and gravel a byelaw was approved prohibiting the erection of a building until a layer of sound and suitable material sufficient to elevate the site to an adequate height had been deposited thereon. It seems generally desirable to treat a site that is naturally damp or soaked in moisture in this way, for an ordinary field drain is not permanently efficient, and there is no security that the trap will always prevent the passage of foul air into a porous subsoil.

The Metropolitan Byelaws require that, unless a site is gravel, sand, or natural virgin soil, it shall be covered with a layer of good concrete 6 inches thick, and smoothed on the upper surface. This concrete, which is usually made with lime, is of very little practical utility, and the exception of certain kinds of site is very unfortunate. The Model Byelaws admit of no exceptions, and require the site to be covered with asphalte or with a 6-inch layer of good cement concrete rammed solid. The object being to prevent the admission of ground air into the house, this cement concrete should be either asphalted or grouted on the surface with cement properly smoothed, as even the best concrete will allow the passage of moisture and of air. The Metropolitan Byelaws are silent as to ventilation under the wooden floors of the lowest story, but the Manchester Byelaws provide for a ventilated space beneath the floor timbers. I have, however, long been convinced that there ought to be no wooden floors of the ordinary construction in the lowest story of a house, and no space, ventilated or unventilated. The air-inlets are invariably stopped up to prevent cold and draughts, and, at the best, the space must be a means of introducing stagnant or ground air into the house. If brick or stone paving would be too cold, floor-boards 1½ inch thick, Burnettized or Ryanized, may be nailed to narrow fillets embedded in the concrete about 3 feet apart, or they may be nailed to a layer of coke breeze and cement, concrete, or the ordinary wood flooring blocks may be used. Thus the cost of excavation and of floor timbers may be saved, and a solid impervious floor obtained.

Burnt bricks and bad mortar permit the passage of moisture through walls. Mortar and plaster mixed with putrid or earthy matter increase this mischief and pollute the air. The Metropolitan Buildings Acts and Byelaws demand good, hard, sound, well-burnt bricks, and mortar composed of fresh burnt lime or cement and clean sharp sand or grit "without earthy matter." This last item is very important, for earthy matter can be easily detected by the eye and separated by analysis. The London Council General Powers Act, 1890, gives power to the Council to regulate the composition of plaster, which hitherto could be made chiefly of foul road scrapings or garden mould. The materials demanded will be generally similar to those required for mortar.

The provision of a damp course near the base of a wall is most important. The Metropolitan Byelaws demand that it shall be of "asphalte or other material impervious to moisture" placed one foot above the level of the ground in external walls, and six inches below the lowest floor in internal and party walls. Thus in external walls there is no provision against the passage of damp at the level of the ground or below that level. The Manchester Byelaws require a damp course of sheet lead of four pounds to the inch, asphalte half an inch thick, or

slates laid in cement, or of other material impervious to moisture beneath the lowest timbers and at the level of the surface of the ground. If the lowest floor is to be below the surface of the ground the external wall must be double, having a cavity of two inches between the outer and inner portions and extending from the base of the wall to the surface of the ground, with one damp course at the base of the wall and another at the top of the cavity. The Model Byelaws suggest that the cavity should extend to six inches above the surface of the ground, and even that is hardly enough to provide against the splashing of rain. The least that should be demanded is an outer covering or rendering of the wall with asphalte or some effectual material carried down from the damp course which is above the ground to a damp course that is below the floor. But it would not be very unreasonable to demand that the whole of the lowest part of the wall, up to a height of twelve inches above the ground, should be built of hard bricks bedded in cement mortar, as is very usual in good work. There does not appear to be any legal authority at present for demanding a dry area, or even an external coating for the protection of the lower part of a wall, these matters not forming part of the wall.

The supply of light and fresh air to habitable rooms, and the provision of sufficient air-space may be secured by requiring that the rooms be made of adequate size, and particularly of sufficient height—and that they have suitable windows overlooking open spaces. The Metropolitan Buildings Act, 1855, provides that unless all the rooms in a dwelling-house can be lighted and ventilated from a street or alley adjoining, it shall have in the rear or on the side an open space exclusively belonging to it, measuring 100 square or superficial feet. But it has been legally decided that the light and ventilation need not come directly from the outside, and if they are admitted through another room no open space need be provided. If the open space is provided there is no power to secure that any room shall be lighted or ventilated from it. The Amendment Act of 1882 requires that every new dwelling-house erected upon a site not previously occupied in whole or in part by a building shall have directly attached thereto, and in the rear thereof, and extending throughout its entire width, an open space of not less than 150 square feet. If the frontage exceeds 15 feet in length, the space must measure 200 square feet, a frontage over 20 feet must have an open space of 300 square feet, and a frontage over 30 feet must have a space of 450 square feet. But it is permitted to cover the whole of this space with buildings not higher than the ceiling of the ground floor storey of the main structure. In many cases this is very inadequate. The Model Byelaws fix the size of the open space at a minimum of 150 square feet but increase the area in proportion to the height and length of the house. In any case the distance from the rear of the house across the open space must be not less than 10 feet, but if the house is 15 feet in height the distance must be 15 feet—if the height is 25 feet the distance must be 20 feet—and for 35 feet or more of height the distance must be 25 feet, and these widths must be carried all along the rear of the building. These byelaws also enforce open spaces in front of dwelling-houses, and a similar result is obtained by the Metropolitan Regulations

which fix the widths of streets and the heights of buildings. These Model Byelaws also demand that every room shall have a window measuring one tenth of the area of the floor, and one half of it must open so that the opening extends to the top. This window must overlook an open space. And if a room has no fireplace it must have a ventilating opening or shaft of 100 square inches in area. The Berlin Regulations of 1887 provide that lobbies, vestibules, and corridors that have no windows must have tubes or pipes for ventilation. It is difficult to fix by law the size of a habitable room. The Metropolitan Building Act requires that every habitable room shall be 7 feet high in every part, except rooms in the topmost story, which must be 7 feet high over one half of their area. If in a basement, they must have (in accordance with the Metropolis Local Management Act) 1 foot of their height above the adjoining footway with an open area 3 feet wide along the front.

But the building regulations adopted by the London County Council for artisans' dwellings that are built upon the land which it has to devote to that purpose, indicate the views of that body as to the proper sizes of dwelling-rooms for the lowest class of the population that inhabits separate tenements. The assumption is that the average population will be two persons per room, and the standard height of rooms is to be 9 feet. A one-roomed dwelling is not to be of a less area than 144 square feet; in a two-roomed dwelling the additional room is to measure at least 96 feet square; and in a three-roomed dwelling the third room is also to be of this size. Basement rooms are not to be sunk more than 3 feet below the adjoining pavement, and waterclosets are not to be immediately accessible from dwelling-rooms. These closets are, in those dwellings, generally so arranged with regard to the scullery that a current of air will pass to the other rooms through the scullery and not through the closet. The Model Byelaws provide that the closet shall adjoin an external wall, and shall have a window measuring 2 feet by 1 foot, also a ventilating air-brick or air-shaft; but no regulations can secure these contrivances from being stopped up by the occupiers. It is, I think, a source of evil to assume that a watercloset must be a foul place, and to trust to remedial precautions which, in practice, will never be taken. A closet should, by its construction, be rendered so free from impure air that nothing beyond a window should be necessary to keep it sweet.

The last item I have to notice is the structural measures necessary for the removal of refuse from the house. The modern practice being to take all the liquid refuse of town houses into a public sewer, no question of cesspool construction can arise where sewers exist, and a cesspool cannot in any case be constructed in or near to a house. Questions of house drainage will be dealt with in another department of this Congress, and we have only to notice the structural means of getting liquid refuse into the drain. There are in the metropolis no very precise regulations for that purpose, but byelaws are now under consideration. The Model Byelaws require that the soil-pipe from a closet or slop sink shall be fixed outside a house, and shall be thoroughly ventilated. The waste-pipe from a bath, lavatory, or ordinary sink

must discharge outside the building over a channel leading to a trapped gully 18 inches distant. But there is no provision for a trap under the sink, which is necessary, and there is no satisfactory provision for the trap which forms part of the closet apparatus.

An earth-closet must be lighted and ventilated, as in the case of a watercloset, but I think no earth-closet should be permitted within a building, though with proper arrangements it may be placed close to a building. Privies and ash-pits, where they are permitted, must be placed 6 feet from a building, and 100 feet from any source of water supply. The Model Byelaws give detailed regulations as to these matters. Ashpits (or dustbins) for "dust, ashes, rubbish, and dry refuse," must be built of brickwork, and may contain 6 cubic feet, or such less amount as may be equal to the accumulation of one week. This is a great source of evil, for the kitchen refuse has to be mixed with it. In the city, which forms rather over a square mile of the metropolis, this refuse is collected daily, and no accumulation beyond one or two days ought to be permitted. I think that kitchen refuse should not be mixed with the ordinary dry refuse, such as dust, ashes, and hard-core; the mixture spoils both articles, producing a putrid mass that is unmanageable, and of little value.

I have now given the details of those structural regulations which in this country have been generally considered necessary for ensuring the healthy condition of a house, together with a few observations thereon. Had time permitted I should have been glad to compare our regulations with those in force in the chief continental countries, some of which are very elaborate, but I hope that these will be adequately brought out during this Congress.

The structural conditions of a healthy house do not appear to be numerous, but they are exceedingly difficult to define so that they can be clearly understood and enforced by law. It ought not to be possible to build a house in which the conditions necessary to healthy occupation are violated. Indeed, this can be prevented where the Model Byelaws are in operation, which forbid the occupation of a house until it has been certified to be fit for human occupation. But if this care is necessary in a new house, its necessity can hardly be disputed in the case of old houses, where the conditions are notoriously unsatisfactory. It has been proposed to bring these houses gradually under inspection by fixing a period after which the public authority will be authorised to inspect and order the amendment of defects. This is a matter which, both as to regulations and as to inspection, will demand the greatest care and caution. If it is established, it should apply to all houses without distinction of size or of the class of their occupiers, so that the whole population, the interest of which, as regards health, is common and cannot be divided, should be protected by public law from evils over which individuals can have but little control. And amongst the many sources of sickness and premature death, we should be freed from those which spring from the faulty construction of the house.

DISCUSSION.

Professor Aitchison, A.R.A., said, with regard to the sanitarily-constructed dwelling-houses, they were probably used by mechanics or persons who might be looked upon as the aristocracy of labour. But probably half the population of London did not earn more than about 10*s.* a week, and all these regulations, providing for sand, well-burnt bricks, mortar, best burnt lime, asphalte, and all sorts of things, were absolutely impossible, as these people could not pay the rent for such dwellings. But something must be done to render the habitation of the poor possible. He did not see what could be done unless the wages were to be raised, but that was a question of population, and at present people were willing to work at the lowest wage to avoid starvation. For the houses of the largest class of persons in large towns there was much difficulty in meeting most of these requirements, for the speculative builder knew perfectly well that his houses were useless unless they could be let at a certain price. The consequence was that every kind of bad material and bad workmanship was put into requisition; and every attempt was made to outwit those who were appointed to see to the carrying out of the regulations.

Mr. Coard S. Pain (Liverpool,) said they were all fully acquainted with the fact that it was a greater difficulty to enforce byelaws, however excellent in themselves they might be, than to make them. All of them who had had anything to do with the superintendence of buildings must know how utterly impossible it was to get the byelaws carried out if the builder was short of money or otherwise unable to do his duty. He thought that the official of the local authority should be jointly appointed by the Local Government Board and the rural or urban sanitary authority. They all knew that the general public was utterly indifferent to what was going on. The local authorities were, to a large extent, composed of people directly interested in not carrying out the regulations. One might be as smart as possible, but he would back the jerry builder against the smartest. Unless one actually sat upon the job, it was impossible to compete with him; he would cheat them under their very noses, and the local authorities backed him up for many reasons. One member might be the owner of a great property; another element in the local authority was usually the speculating builder; and it was most difficult for the official, however honest he might be, to fight against these influences. That difficulty should be removed, and he thought the adoption of the suggestion he had made would remove it, the more so as another difficulty in getting the byelaws carried out was the frequent inefficiency or ignorance of the official. He was referring to small communities of from 2,000 to 6,000 inhabitants, just large enough to demand the services of a sanitary official. A carpenter, possessed of no particular knowledge, was appointed as surveyor, and he had come across a surveyor recently who was not even acquainted with the byelaws. The law could not make a man honest, but it could insure the appointment of a competent man.

Dr. G. B. Longstaff, Member of the London County Council, felt some hesitation in rising in the presence of so many experts of whom he expected to seek information rather than to afford them any. It was important that architects should give information to individuals like himself as to what were really the essential points in building legislation to aim at. He would recommend them to throw aside all minor matters,

but to fight for those of great importance. Thus he would like to have the general opinion of architects upon Mr. Blashill's proposal to construct the ground floor with concrete and wood, a suggestion which he thought was quite a new one. If wood was used at all, it should be placed on concrete direct. The advantages were clear enough, but he wanted to know whether such a floor was practicable and durable, and whether a nuisance would not arise from the decay of the wood? It would be impossible to compel the people in London to live on concrete or stone or any similar material. They should have an impervious floor, but covered with wood or other non-conducting material. The greatest difficulty was the great respect which Englishmen always showed, and rightly showed, for vested interests, but the question arose whether the consideration of these vested interests had not gone too far. The Act of Parliament of 1855 gave many powers to the governing body of London to carry out provisions in all buildings which were not erected previously, but a long time had elapsed since then. People had learnt something, and the question was whether it was not time to strike out the existing clauses exempting all houses erected prior to 1855. They should also insist upon suitable open spaces, whether the sites had been occupied previously to 1855 or not. In should not be allowable to pull down an ancient street and build a new one of the same width, or to build a new house on the site of an old one covering the same or a larger area up to an indefinite height. Guides on these points would be of very great value. It was common knowledge, he supposed, that the Government had promised to bring in a Bill for the Consolidation of the Metropolitan Buildings Acts, and that a Committee of the County Council would probably be employed for many months to come in considering the details to be proposed to the Government.

Mr. Edward Bond, Chairman of the East-End Dwellings Company, said that in the model byelaws as sketched out by Mr. Blashill, he found little to object to, and nearly all the regulations he had suggested were such as an honest person doing his duty might very well submit to carry out. But there was the difficulty that a great number of people who went in for building speculation did not very much care what sort of houses they put up as long as they could erect them at the least possible cost. It was a matter of extreme difficulty to secure that byelaws, however excellent in themselves, should be positively enforced and carried out by those whose duty it was to see them carried out. At the present moment, however, they did not discuss the difficulties to be overcome, but what the ideas were as to framing our byelaws. There was nothing unreasonable in the suggestion implied by Mr. Pain in the opening of this discussion, but he could not agree with all that had been said about houses erected previous to 1855, and some of the suggested difficulties did not exist. He should be sorry to think, with Professor Aitchison, that only 10*s.* a week was earned by the average London working man. He would like to know where he had obtained that figure, seeing that, from his own observation, it must be very far from the exact truth. He did not think that the conclusion arrived at by Mr. Charles Booth in his book on London life was very wrong, according to which there was a large number of people earning from 15*s.* to 18*s.* a week. It was very difficult to settle the question how such people, who could only afford to pay 2*s.* 6*d.* to 3*s.* a week for rent, rates, and taxes, could best be lodged. The company with whom he was connected had made some attempts in that direction, and had found they had rooms for people of that class which would be found to satisfy Mr. Blashill's suggested byelaws, varying from

3*s*. 6*d*. to 2*s*. 6*d*. and 2*s*. a week. They had been able to pay their shareholders a dividend of 4 per cent., which was now likely to reach as much as 5 per cent. They did not confine themselves to buildings of that class, but catered also for people who could afford to pay considerably higher rents. He ought to mention that most of the sites upon which their houses were built, and which had been cleared by the Metropolitan Board of Works or by the County Council under the Artisans' Dwellings Act, they had acquired at a rate very much below the strict market value. When he spoke, therefore, of having to a certain extent solved the problem, it should be taken into account that they had paid less for their land than it would have cost in the open market. Otherwise he doubted whether they would have been able to provide rooms which the people could have inhabited, and also to pay a good remuneration to those who had entrusted them with their money.

The Rev. Harry Jones said he was in favour of pulling down any bad house, whatever inconvenience it might cost to anyone. A bad man would sometimes make a bad house, but a bad house would inevitably make a bad man.

Mr. H. H. Statham said he could not agree with the conclusions of his friend, Professor Aitchison, which he thought were entirely false humanity, and illogical. If byelaws were to be relaxed because properly-built houses were beyond the means of the poorer class, in two or three generations we might reach the point where they could only afford straw huts, and the authorities would be called on to permit those in the byelaws. The enforcement of good building tended to keep up a healthful standard of life, and was a benefit to the community.

Mr. Edwin T. Hall wished to urge the necessity of excluding ground-air and sewer-gas. There was a lamentable want of power to do this in the Building Acts governing the metropolis. There was no regulation whatever having for its object the exclusion of ground-air as such. "Sewer-gas" was guarded against, but it must be remembered that ground-air was almost as deleterious. They would remember that experiments had been made showing that air went through walls of houses at the rate of 16 cubic feet per hour at 30 deg. difference of temperature, and at a difference of 5 deg. the rate was 17 cubic feet. When they remembered that ground-air was charged with carbonic acid gas and gases from organic matters, they would see how deadly this was to the persons inhabiting such rooms. The floor should be protected by asphalte, of which he had been an advocate for many years. There should be no space under the floor, that being a reservoir for stagnant air. They could get no syphon action to ventilate it, the ground being in most cases level on each side. In upstair rooms it was also important, though not necessary, to have a solid concrete floor. With regard to virgin soil, that seemed to him to be anything except absolute refuse. They might take the grass off a field and build on that, which would be virgin soil, whilst it should be law that the lowest room in a house should be built on an impervious material. Nor was the Act adequate in other respects. It provided for one watercloset in a house, but, having put that one closet in, which complied with the Act, fifty others might be put in that did not. Dr. Longstaff had referred to the necessity of having windows to more than one side of the house, and the difficulty about that had also been pointed out. He thought that, for such cases, dispensing power should be given to some one by the County Council. They should provide regulations for the ninety-nine cases that formed the rule, and not for the one

but to fight for those of great importance. Thus he would like to have the general opinion of architects upon Mr. Blashill's proposal to construct the ground floor with concrete and wood, a suggestion which he thought was quite a new one. If wood was used at all, it should be placed on concrete direct. The advantages were clear enough, but he wanted to know whether such a floor was practicable and durable, and whether a nuisance would not arise from the decay of the wood? It would be impossible to compel the people in London to live on concrete or stone or any similar material. They should have an impervious floor, but covered with wood or other non-conducting material. The greatest difficulty was the great respect which Englishmen always showed, and rightly showed, for vested interests, but the question arose whether the consideration of these vested interests had not gone too far. The Act of Parliament of 1855 gave many powers to the governing body of London to carry out provisions in all buildings which were not erected previously, but a long time had elapsed since then. People had learnt something, and the question was whether it was not time to strike out the existing clauses exempting all houses erected prior to 1855. They should also insist upon suitable open spaces, whether the sites had been occupied previously to 1855 or not. In should not be allowable to pull down an ancient street and build a new one of the same width, or to build a new house on the site of an old one covering the same or a larger area up to an indefinite height. Guides on these points would be of very great value. It was common knowledge, he supposed, that the Government had promised to bring in a Bill for the Consolidation of the Metropolitan Buildings Acts, and that a Committee of the County Council would probably be employed for many months to come in considering the details to be proposed to the Government.

Mr. Edward Bond, Chairman of the East-End Dwellings Company, said that in the model byelaws as sketched out by Mr. Blashill, he found little to object to, and nearly all the regulations he had suggested were such as an honest person doing his duty might very well submit to carry out. But there was the difficulty that a great number of people who went in for building speculation did not very much care what sort of houses they put up as long as they could erect them at the least possible cost. It was a matter of extreme difficulty to secure that byelaws, however excellent in themselves, should be positively enforced and carried out by those whose duty it was to see them carried out. At the present moment, however, they did not discuss the difficulties to be overcome, but what the ideas were as to framing our byelaws. There was nothing unreasonable in the suggestion implied by Mr. Pain in the opening of this discussion, but he could not agree with all that had been said about houses erected previous to 1855, and some of the suggested difficulties did not exist. He should be sorry to think, with Professor Aitchison, that only 10*s.* a week was earned by the average London working man. He would like to know where he had obtained that figure, seeing that, from his own observation, it must be very far from the exact truth. He did not think that the conclusion arrived at by Mr. Charles Booth in his book on London life was very wrong, according to which there was a large number of people earning from 15*s.* to 18*s.* a week. It was very difficult to settle the question how such people, who could only afford to pay 2*s.* 6*d.* to 3*s.* a week for rent, rates, and taxes, could best be lodged. The company with whom he was connected had made some attempts in that direction, and had found they had rooms for people of that class which would be found to satisfy Mr. Blashill's suggested byelaws, varying from

ls. 6*d.* to 2*s.* 6*d.* and 2*s.* a week. They had been able to pay their shareholders a dividend of 4 per cent., which was now likely to reach as much as 5 per cent. They did not confine themselves to buildings of that class, but catered also for people who could afford to pay considerably higher rents. He ought to mention that most of the sites upon which their houses were built, and which had been cleared by the Metropolitan Board of Works or by the County Council under the Artisans' Dwellings Act, they had acquired at a rate very much below the strict market value. When he spoke, therefore, of having to a certain extent solved the problem, it should be taken into account that they had paid less for their land than it would have cost in the open market. Otherwise he doubted whether they would have been able to provide rooms which the people could have inhabited, and also to pay a good remuneration to those who had entrusted them with their money.

The Rev. Harry Jones said he was in favour of pulling down any bad house, whatever inconvenience it might cost to anyone. A bad man would sometimes make a bad house, but a bad house would inevitably make a bad man.

Mr. H. H. Statham said he could not agree with the conclusions of his friend, Professor Aitchison, which he thought were entirely false humanity, and illogical. If byelaws were to be relaxed because properly-built houses were beyond the means of the poorer class, in two or three generations we might reach the point where they could only afford straw huts, and the authorities would be called on to permit those in the byelaws. The enforcement of good building tended to keep up a healthful standard of life, and was a benefit to the community.

Mr. Edwin T. Hall wished to urge the necessity of excluding ground-air and sewer-gas. There was a lamentable want of power to do this in the Building Acts governing the metropolis. There was no regulation whatever having for its object the exclusion of ground-air as such. "Sewer-gas" was guarded against, but it must be remembered that ground-air was almost as deleterious. They would remember that experiments had been made showing that air went through walls of houses at the rate of 16 cubic feet per hour at 30 deg. difference of temperature, and at a difference of 5 deg. the rate was 17 cubic feet. When they remembered that ground-air was charged with carbonic acid gas and gases from organic matters, they would see how deadly this was to the persons inhabiting such rooms. The floor should be protected by asphalte, of which he had been an advocate for many years. There should be no space under the floor, that being a reservoir for stagnant air. They could get no syphon action to ventilate it, the ground being in most cases level on each side. In upstair rooms it was also important, though not necessary, to have a solid concrete floor. With regard to virgin soil, that seemed to him to be anything except absolute refuse. They might take the grass off a field and build on that, which would be virgin soil, whilst it should be law that the lowest room in a house should be built on an impervious material. Nor was the Act adequate in other respects. It provided for one watercloset in a house, but, having put that one closet in, which complied with the Act, fifty others might be put in that did not. Dr. Longstaff had referred to the necessity of having windows to more than one side of the house, and the difficulty about that had also been pointed out. He thought that, for such cases, dispensing power should be given to some one by the County Council. They should provide regulations for the ninety-nine cases that formed the rule, and not for the one

forming the exception. The difficulty he had long felt of enforcing all penalties for breaches of byelaws should be met by placing the duty of the prosecution upon the police.

Mr. W. N. Elliott, of Plymouth, considered the erection of dwellings under sanitary conditions to be the first consideration, as all enjoyment of life depended upon it, and he thoroughly approved of the means suggested for the purpose in the paper. In Plymouth, concrete beneath the floors of houses was compulsory, except the site was on a solid rock. Sanitary inspectors had to contend with the difficulty arising from the fact that insanitary buildings were often the property of members of the local authority, and great influence was brought to bear upon the officials of the borough, interfering with the exercise of their duty in a conscientious manner. If these inspectors were independent men, and were paid from an independent source, the results would be more satisfactory. Then if the expense of erecting healthy dwellings for the poor was really so great that their inhabitants could not pay the rent, he did not see why State aid should not be granted. Some of the speakers had confined their remarks to London, but in an International Congress they had to deal with all towns.

Dr. Sykes called attention to the fact that the title of the paper was the "Control of the Construction of *Buildings*," not *dwellings* only. He laid stress upon this point because he wished to mention something that bore materially on that question. Buildings were inhabited or uninhabited. Uninhabited buildings affected the health of the population only by external influences, while inhabited buildings affected it externally and internally. Those who were acquainted with English legislation would last year have seen an Act,—the Public Health Amendment Act,—in which there was a clause introducing a totally new feature into the building legislation. The clause was to the effect that any building that had not been erected for the purpose of a dwelling should not be used as a dwelling until permission had been obtained for its being so used from the surveyor or architect of the district. A building might be erected which was not intended to be dwelt in, and yet be used as a dwelling-house, whilst, *vice versâ*, a dwelling-house might be converted to other uses. It was through this conversion that the whole difficulty in building legislation arose, and he hoped that the County Council would adopt measures for preventing a stable-loft,—he was going to say a kennel,—being used as a dwelling without being rendered fit for habitation. He spoke from personal experience as a medical officer of health.

Mr. E. T. Brydges, Town Clerk of Cheltenham, wished to point out with reference to the remarks made by Dr. Sykes about the Public Health Amendment Act, that that Act was an adoptive Act, which had the serious defect that one could not adopt sections of it, and, for that reason, local authorities had, in many cases, not been able to avail themselves of it. He agreed that byelaws should apply to all houses irrespective of date of erection, and that any unhealthy house should be pulled down.

Mr. H. H. Collins desired to protest against over-legislation. That the Building Act required some remodelling, one could admit. But as it had been 36 years in operation without having given rise to serious complaints, notwithstanding the serious alteration of circumstances, he thought that spoke well for the Act and for those who had framed it.

On Furnishing Steam from Central Districts for Heating and Power in Towns and Cities.

BY

S. M. BURROUGHS.

As water, gas, and electricity have been found most convenient and economical when supplied to the general public from central sources, the idea was suggested, and has been found practicable in its working, of supplying steam from mains laid under the streets from which it can be conveyed either for heating purposes or for power. The first practical experiment in this direction was made by Mr. Holly, of Lockport, New York, the inventor of the Holly system of large pumping engines. The system is very simple. It consists of boilers in central stations supplied with smokeless furnaces adapted to the consumption of coal-dust, which would otherwise be wasted. The steam is conducted through the streets in large mains composed of wrought iron lap-welded pipes. Contraction and expansion are duly provided for by means of service variators which have secured unlockable joints. The pipes are covered with non-conducting substances which prevent the radiation of heat. This can be secured by covering the pipes with magnesia or asbestos, and enclosing them in logs of wood with holes bored to suit. The steam can be supplied at a high pressure, say at 80 pounds, and can then also be used for driving engines, pumping water, &c., &c. By means of reducing valves the pressure can be reduced to 3 pounds on the square inch; and by the use of steam meters, the quantity of steam taken by each customer can be measured. The New York Steam Company now furnish steam for 600 engines from one station. They also supply heat for the city Post Office, the Western Union Telegraph building, and for many other buildings. Their profits are rather more than 33⅓ per cent., and their customers find this method of heating more economical and desirable than any other. Heat is supplied by this system the same as water or gas; it is on tap, and can be had at any time, day or night, by simply turning a valve. While there have been killed in New York in one year, by horse-cars 64, by waggons 55, by gas 23, by electric current 5, not a single case of death has occurred through the use of steam by this system. Mr. F. H. Prentiss, the chief engineer and general manager, gives the following affidavit:—"I am chief engineer and general manager of "the New York Steam Company, and have been in the employ of said "company and familiar with its affairs for seven years. There has never "been an explosion of a steam-pipe of this company in the streets of "New York; there has never been a paving stone lifted, to my "knowledge, except by a crow-bar, in the usual way. All talk of "explosions in this connexion is supreme nonsense. The sudden "generation of force necessary to produce an explosion, which can and "does take place in a steam boiler, cannot occur in the street pipes. I "state, as an engineer and expert in steam matters, that such a thing is

" physically impossible, as there is no fire under the pipes in the streets. " They are as safe and free from explosion as Croton Water pipes."

There is abundant evidence, not only in New York city but in other places where this system has been employed, to prove that it has given general satisfaction, and to indicate that there is a future of great usefulness before it. It can be utilised with great advantage by electric lighting companies, because they can employ their waste steam for the purpose. The Edison Electric Company of Kansas City paid the cost of the investment from the first year's income. The system is especially useful for college buildings, asylums, &c. The mains should be laid down from 4 to 6 feet underground. No man-holes are necessary; the variators should be placed about 50 or 100 feet apart, and should be enclosed with brick. The pipes enter buildings through a cellar or basement, and connect with radiators wherever required. The condensed steam is usually conducted into the basement, where it passes through coils exposed to a current of fresh air from the outside; this abstracts from the steam the remaining heat and then passes upward into the rooms where required for heat and ventilation. The water is of course also pure, and can be used for general household purposes; or, if not required, can be passed into the sewer. If steam is required for heating water, it can be easily carried into a little gravel at the bottom of a basin or tub. The steam can also be used conveniently in drying rooms for drying clothes; it can also be used for forcing water upstairs to tanks by means of steam pressure; also for green-houses and conservatories; and likewise for cooking. It is a great protection against fire, because, if steam is turned into any room where there is a fire it speedily extinguishes it. The risk of fire is greatly reduced by the employment of such a system. The loss of heat, when the main pipes are well covered, is considered to be not more than 5 per cent. The system has been found economical, and has been adopted in competition with good coal at 2½ dollars per ton. A few of the advantages are, briefly; *First*, convenience; *Second*, absence of fireplaces and stoves, and of the risks attendant upon them; *Third*, uniformity of temperature is easily secured; *Fourth*, absence of dust, smoke, and noxious gases which come from coal, gas, or petroleum; *Five*, economy; *Six*, absence of danger from explosions, economy of labour over the use of separate boilers; utility over supplying the steam for power.

In 1891 the Holly system was in use in 29 towns in the United States; also for heating power in different buildings in these towns. The adoption of such a system would, I should think be particularly desirable in London, and might be the means of abolishing the smoke and fog nuisance. It has been found that the value of land along streets where the steam mains are laid has been considerably increased thereby. If therefore, the supply of steam should be taken in hand by municipal authorities, a considerable amount of the cost could justly be defrayed by taxing the increased values imparted to adjacent land by the laying down of steam-mains.

DISCUSSION.

Mr. R. A. Robinson said he was glad that Mr. Burroughs had brought the idea of this improvement to London. He saw no reason why the plan could not be carried out, to judge by the evidence adduced by the lecturer. He would like to know, however, how far steam could be carried. Another point was that our streets were already filled up with underground pipes, and he had some hesitation in advocating the insertion of more pipes than were absolutely necessary. He would like, however, to see the system tried, as it would be of great importance to London.

Mr. John Atha (Leeds) pointed out that, through conducting steam in pipes underground for long distances, part of the steam would be condensed into water, and thus in a short time interfere with the proper working of the system.

Mr. Burroughs, replying to various queries, said that the size of the pipes depended upon the demand. The main would have to be large, perhaps 8 in. or 9 in., but much smaller pipes would convey the steam into the houses. He had not heard of the subsidence of the soil causing any serious difficulty, but they were in the same position as with water and gas. So far the scheme had been carried out with great satisfaction in the United States, and it has also been found that it tends to an improvement in the sanitary condition of the towns. As to the collection of condensed water, there were traps provided into which such water would fall.

Wednesday, 12th August 1891.

The President, Sir Arthur Blomfield, in the Chair.

Sur la Constitution Hygiènique des Murs d'Habitation.

PAR

M. le Prof. Emile Trélat, Directeur de l'Ecole Spéciale d'Architecture, Député de la Seine.

Les murs des habitations modernes sont toujours exclusivement établis en conséquence de deux idées fondamentales :—1°. Une idée techique qui porte à rechercher des matériaux capables de durer dans le temps, de résister aux charges mécaniques auxquelles ils seront soumis dans la construction et de fournir à la perspective de l'édifice des ressources plastiques en rapport avec l'expression architecturale désirée ; 2°. Une idée économique qui porte à rechercher des matériaux faciles à travailler et peu coûteux à obtenir.

Il faut ajouter que dans les villes qui s'étendent sans cesse et absorbent de plus en plus les populations des campagnes, l'espace manque au constructeur, ce qui lui commande de réduire la place occupée par les *pleins* de ses édifices. Les murs doivent donc y être aussi minces que possible. Ils sont aujourd'hui d'autant plus minces

que les villes sont plus populeuses et l'habitation plus dense. Comme d'ailleurs, les constructions à la campagne prennent de plus en plus modèle sur celles des cités, on peut dire d'une manière générale que la tendance actuelle du constructeur est de réduire l'épaisseur des murs.

Je voudrais fixer l'attention de la Section sur les conséquences de la routine que je viens de décrire et montrer qu'il y a nécessité de faire intervenir dans le problème des considérations absolument négligées aujourd'hui.

Pour cela il faut envisager le mur de maison, non plus seulement comme un organe de la construction, mais comme un facteur du bien-être et de la salubrité intérieure. C'est, en effet, entre les murs qui enclosent nos logements que doivent être aménagés le confort et la sécurité de l'habitation. A ce point de vue les murs sont, d'abord, pour l'habitant des parois de protection contre les intempéries : pluies, vents, écarts et excès de températures atmosphériques. Ils sont, en second lieu, des intermédiaires qui doivent favoriser autant que possible la reconstitution de la salubrité intérieure sans cesse compromise par le fonctionnement de la vie pendant que les locaux sont habités.

On infère facilement de ces conditions de service des murs la nécessité de définir leurs capacités :—1°. Au point de vue de la protection qu'ils fourniront à l'intérieur contre les *variations* atmosphériques ; 2°. Au point de vue de leur influence sur l'état atmosphérique intérieur.

I.—*Capacités des murs au point de vue de la protection qu'ils doivent assurer à l'intérieur contre les variations atmosphériques.*

Les variations atmosphériques sont *mécaniques*, *hygrométriques*, ou *thermiques*.

Les variations *mécaniques* sont dûes aux mouvements de l'atmosphère qui est calme ou venteuse ou tempêtueuse. Les murs, comme on les construit couramment, sont toujours des protecteurs suffisant à ces sortes de désordres. Il n'y a pas à s'en occuper ici.

Les variations *hygrométriques* sont tributaires des saisons, des climats et des sites. L'atmosphère est alternativement sèche ou humide, et ces alternatives sont plus ou moins souvent répetées selon les localités. Un intérieur sain ne supporte par ces changements d'états. L'atmosphère doit y être convenablement chargée d'eau : ni trop sèche, ni trop humide. Les variations extérieures ne doivent pas sensiblement l'influencer. On voit intervenir ici non seulement une question. d'épaisseur de parois, mais une question de constitution matérielle de ces parois. En laissant de côté l'épaisseur qui est généralement suffisante dans la pratique courante, on constate, que certains matériaux de construction donnent très facilement passage à l'eau, tandis que d'autres l'interceptent complètement. Les grès, notamment ceux de formation tertiaire, comme les *grès de Fontainebleau*, sont dans e premier cas. Un morceau de grès de Fontainbleau, d'une épaisseur très notable (50 ou 60 centimètres) en contact avec l'eau sur une de ces faces, laisse voyager le liquide dans ses profondeurs et atteindre après

quelques heures la face opposée. Au contraire, du granite ou du calcaire placés dans les mêmes conditions ne se laisseront pas sensiblement pénétrer par l'eau. On peut dire qu'au *point de vue hygrométrigue* la conservation d'une atmosphère intérieure saine demande des parois composées de *matériaux imperméables à l'eau.* Les variations *thermiques* extérieures dépendent encore des climats, des saisons et des sites, qui gardent les nuages au ciel ou qui les en éloignent. Les surfaces du sol et de ses reliefs sont influencés par l'état thermique de l'atmosphère; et, quand celui-ci persiste, les échauffements au les refroidissements de ces surfaces pénètrent dans les profondeurs.

Une parois d'habitation est un protecteur effectif contre les changements de température quand elle arrête dans son corps, sans le laisser traverser, les variations thermiques auxquelles est soumise sa face extérieure; en d'autres termes, quand elle est pourvue d'une suffisante capacité d'isolement. Le type d'une semblable paroi pourrait se définir ainsi :—Elle serait composée d'une matière assez isolante et elle serait assez épaisse pour que les écarts de température extérieure n'eussent jamais le temps d'atteindre les profondeurs de l'ouvrage jusqu'à gagner la face intérieure. Les échauffements et les refroidissements du mur s'opéreraient ainsi sans modifier l'état thermique de la surface intérieure qui enveloppe les habitants et agit constamment sur eux par rayonnement. Une semblable paroi dans nos latitudes, entre le 42e et le 52e, degré, devrait avoir 2^{m} et plus d'épaisseur. On trouvait de pareilles conditions dans les vieilles constructions de l'antiquité et du moyen-âge. Il était alors facile d'entretenir dans l'habitation une régularité de température sensiblement constante. La surface intérieure des murs ne subissait que de légers écarts de chaleur auxquels on remédiait sans peine, à l'aide de simples foyers de cheminées. Nous sommes aujourd'hui très éloignés de conditions aussi favorables avec l'épaisseur réduite de nos murs. La face intérieure s'en refroidit considérablement l'hiver et s'échauffe de même l'été, en sorte qu'elle rayonne offensivement sur nos corps du froid ou du chaud. Pour remédier à cet inconvénient les appareils les plus divers sont employés au chauffage pendant la saison froide et nous en tirons peu de satisfaction en général; tandis que nous sommes dépourvus de palliatifs pendant la saison chaude.

C'est contre ce double mal qu'il faudrait réagir en donnant plus d'épaisseur à nos murs d'habitations. A Paris et dans la France du Nord les constructeurs donnent aux murs de facade une épaisseur de 0.50^{c}. quand on les construit en pierres calcaires, et de 0.35^{c}. quand on les onstruit en briques. La brique (argile cuite) possède une propriété d'isolement sensiblement double de celle du calcaire, si bien que le mur cde briques de 0^{m}.35 est plus protecteur contre les changements de tem pérature que le mur de calcaire de 0^{m}.50^{c}. Ces épaisseurs sont, toutefois, insuffisantes l'une et l'autre. On peut, il est vrai, augmenter singulièrement le pouvoir isolant du mur en l'habillant à l'intérieur d'une doublure en bois ou en étoffe. Le bois est quinze fois plus isolant que le calcaire et sept fois plus isolant que la brique. La laine est vingt-trois fois plus isolante que le calcaire et onze fois plus isolante que la brique. On pourrait donc doubler la capacité d'isolement des murs que nous construisons avec un revêtement intérieur *en bois* de 0.07^{c}, d'épaisseur pour les murs de

calcaire, de 0.m05 pour les murs de briques; avec un revêtement intérieur *en étoffe de laine* de 0m·5 pour les murs de calcaire, de 0 025 pour les murs de briques. Sans prétendre à d'aussi beaux résultats, on voit le parti qu'on peut tirer des matériaux fortement isolants, pour améliorer les murs de face de nos maisons. Quoique ces doublures isolantes soient des remèdes coûteux et restés jusqu'à présent des applications de luxe, c'est à elles qu'il faut recourir si l'on veut remédier à l'insuffisance de protection que nos murs nous fournissent contre les variations thermiques de l'atmosphère. ***Tous nos murs de façade devraient être lambrissés en bois.*** On obtiendrait ainsi, sur les parois exposées aux intempéries une garantie très efficace qui rendrait beaucoup moins pénible l'habitation d'été, et beaucoup plus facile l'entretien pendant l'hiver de la température des enveloppes rayonnantes des salles.

Je place ici une observation que je ne saurais omettre, puisque je parle à Londres et que mes auditeurs sont, en majorité, des Anglais. La capitale de d'Angleterre n'est plus aujourd'hui ce quelle était il y a une trentaine d'années encore, une ville à petites maisons basses, à laquelle s'appliquerait sans réserve tout ce qui vient d'être dit. Après s'être étendue en surface jusqu'à occuper 32,000 hectares, la ville de Londres semble aujourd'hui se ramasser sur elle même, en même temps qu'elle perce les vieux quartiers et se fait des voies nouvelles. Et comme tout se fait vigoureusement et quelquefois excessivement dans ce grand pays, on y voit s'élever des maisons à une hauteur extraordinaire. On en rencontre qui ont jusqu'à 13 et 14 étages, ce qui porte leurs murs à 35 ou 40 mètres de hauteur. Dans ces conditions la stabilité a exigé l'épaississement des murs; et, sans qu'ils le fassent exprès, on voit ainsi les architectes anglais construire des maisons dont les logements sont mieux protégés que ceux des anciennes constructions contre les changements de température. Cette observation n'enlève rien à la netteté du principle de salubrité qui commande à l'habitation d'être close par des murs permettant de maintenir aisément en température sensiblement constante les surfaces intérieures des parois.

II. *Capacités des murs au point de vue de leur influence sur l'état atmosphérique intérieur.*

Toutes les émanations du corps sont délétères. Quand nous vivons en plein air nous échappons à leur influence, soit par ce que nous ne séjournons pas au voisinage des dépôts excrémentiels que nous créons; soit parceque nos déplacements nous éloignent des lieux de l'atmosphère viciés par nos expirations ou nos transpirations; soit, enfin, lorsque nous restons stationnaires, parceque les mouvements de l'atmosphère ou les simples courant verticaux entretenus autour de nous par notre chaleur corporelle déplacent et remplacent les gaz expirés par nos poumons. Mais aussitôt que nous nous enfermons dans nos habitations nous perdons ces bienfaits. L'atmosphère limitée qui nous entoure s'infecte dangereusement si nous ne la renouvelons pas. Malgré les intempéries ce renouvellement s'opère partiellement par les fissures de nos fenêtres et de nos portes, par les vasistas et surtout par les cheminées que nous prenons soin de ménager dans chaque pièce habitée.

Mais tout cela ne suffit pas à maintenir nos corps dans un milieu de salubrité comparable à celui que nous trouvons dehors. Aussi nous efforçons-nous judicieusement, d'ouvrir nos fenêtres aussitôt que le temps le permet, ou que le voisinage bruyant et poussièreux des voies urbaines nous y autorise. Mais dans les longues saisons d'inclémence atmosphérique nous n'ouvrons pas nos fenêtres, nous fermons nos vasistas et notre atmosphère intérieure reste misérable, souvent sensiblement infectée et toujours insensiblement malsaine. Dans maintes circonstances l'infection reste pour ainsi dire collée aux murs. Cela arrive toujours dans un milieu constamment occupé pendant longtemps lorsque les murs ne sont pas *poreux*, c'est à dire perméables à l'air. Au contraire, si les murs sont perméables à l'air, l'infection de surface murale ne se produit pas. Cette perméabilité est une condition de salubrité très précieuse. Il faut la rechercher toujours.

Nous connaissons des matériaux qui se laissent très facilement penétrer par l'air à travers des épaisseurs très considérables. Ainsi se montre le calcaire tendre dont le type peut être pris dans le calcaire grossier du bassin du Paris, qu'on nomme *Vergelé*. Un mur de Vergelé de $1^{m}\cdot00$ d'épaisseur, et plus, laisse passer une notable quantité d'air ou de gaz quelconque. Si on considère une salle habitée, close par un pareil mur, voici ce qui se passe ; l'air extérieur y voyage de dehors en dedans, tandis que l'air intérieur y voyage de dedans en dehors. Ce dernier charrie avec lui les fumiers* humides et gazeux résultant de la vie enfermée. La rencontre de ces deux courants, réducteur et réductible, produit l'oxydation des fumiers et ruine leur action nocive. Il se fait là une véritable épuration tout à fait comparable à celle qu'on obtient sur un champ poreux et perméable arrosé par des eaux d'égout courant en rigoles. On sait avec quelle perfection et quelle rapidité toutes les oxydations salutaires s'opèrent en ce merveilleux laboratoire de salubrité. Les calcaires poreux sont des matériaux très précieux pour la constitution hygiénique des parois d'habitations. Quoique leur porosité les rende facilement pénétrables à l'air, ils laissent difficilement passage à l'eau ; et, sous ce rapport, ils gardent l'avantage des matériaux qui ne laissent pas entrer les eaux atmosphériques dans l'habitation. Aussi doit-on, au point de vue hygiénique, les préférer à tous autres matériaux, aux matériaux perméables comme le grès qui ont l'inconvénient de se laisser pénétrer par l'eau, et qui, alors ne permettent plus à l'air de passer, et aux matériaux comme le granite qui, imperméables à l'eau, ne laissent jamais passer d'air.

Je dois conclure, à la suite de cette communication, par ces trois indications :—

1°. Les murs extérieurs de nos habitations sont aujourd'hui pourvus de capacités isolantes trop faibles pour que nous puissions *régulièrement* entretenir dans nos logements la température normale de salubrité.

2°. Il y a lieu d'accroître ces capacités soit en augmentant l'épaisseur des murs, soit, à défaut de cette augmentation, en

* Mot très juste et très pittoresque du Dr. Rochard.

révêtissant la face intérieure des murs d'une doublure faite en matériaux très isolants, tels que le bois ou les étoffes.

3°. Au point de vue de la pureté atmosphérique intérieure, les meilleures parois sont les murs composés de matériaux perméables à l'air et imperméables à l'eau. Le type de ces matériaux est le calcaire tendre.

DISCUSSION.

Professor T. v. Gruber (Vienna) will nicht den geistreichen Darstellungen des Vorredners widersprechen, macht aber darauf aufmerksam, dass ein sehr grosser Theil der Wände durch die Fenster eingenommen wird, die hier in England wie in Frankreich nicht nur in höchst anerkennenswerther Weise sehr gross, sondern auch stets einfach gemacht sind. Die Wärmetransmission durch das Glas ist aber bedeutend grösser als die durch das Mauerwerk; so lange also nach climatischen Verhältnissen einfache Fenster genügen, erscheint eine Verstärkung der Mauern-Ende nicht nöthig; vortheilhaft ist es aber gewiss, und besonders unter climatischen Verhältnissen, welche die Verdoppelung der Fenster verlangen, in die Mauern "Lichtschichten" als schlechte Wärmeleiter einzuschalten. Wir dürfen nie übersehen, dass wir die Anforderungen der Hygienie nicht zu hoch ansehen, wenn wir den grössten Bedürfnissen der Gegenwart, der Schaffung von entsprechenden Wohnungen für die arme Bevölkerung, Rechnung tragen wollen. Was die Permeabilität der Wände betrifft, ist wohl zu unterscheiden in welcher Weise die Ventilations-Einrichtungen durchgeführt sind. Wo für die Vorwärmung der Beleuchtung und für entsprechende Abzugsschlote vorgesorgt ist, und die richtige Ausnützung dieser Einrichtungen erwartet werden darf, ist es gewiss am besten die Aussenwand der Mauer permeable, die Innerwand aber inpermeable zu gestalten. Wo aber die richtige Verwerthung der Ventilations-Einrichtungen nicht zu erwarten ist, muss man leider noch heute vielfach diese bedauerliche Thatsache constatiren, dort wird die Permeabilität der Innenwände und Mauern das Richtige sein.

Dr. Spottiswoode Cameron (Leeds) thought that there was a danger, in excluding damp, of excluding another precious element, the oxygenating influence of fresh air, which largely took place through the permeability of walls. In many houses the means of ventilation were almost *nil*, but a certain amount of the deleterious gases got out through the walls. Was there not a danger, if we made the walls too impervious, that we might be doing as much harm as good?

Mr. Ralph Nevill, F.S.A., did not agree with Mr. Seddon in his observations on a previous paper in favour of solid walls rather than hollow walls. To make the walls impervious by increasing their thickness was useless, so long as in other parts of a room there was only a single pane of glass between the inmates and the open air. He was of opinion that windows should always be constructed in such a way that there should be an air space always between two sheets of glass forming the windows.

Mr. H. H. Statham said he was disposed to agree with the last speaker, that it was of no use to increase the thickness of walls while we had glass windows occupying so large an area of wall space. In

England we were not accustomed to double sheets of glass, with an ½ in. air space between.

Mr. H. H. Collins said that Pettenkofer gave instances of houses for the working classes built of iron slag, which was supposed to be impermeable. But such houses were found to be extremely uninhabitable, because, at certain seasons, water would be found running down the interior walls. The speaker agreed with Mr. Neville with regard to hollow walls, and, he would add, hollow windows.

Mr. W. P. Buchan (Glasgow) said he doubted whether the double window with ½ in. or 1 in. interspace would prove as effective as some of them anticipated. He knew a church in Glasgow where the windows were double and of large size, in which the cold was bitterly complained of. He was of opinion that experiments should be made in the period of winter to ascertain the proper interval between two sheets of glass in order to prevent the escape of heat. Half an inch appeared to him too little. The most effective interval was probably between ½ in. and 1½ ins., or, perhaps, 2 ins. It would be a great advantage to have the matter settled by careful experiment.

M. Trélat, in replying on the discussion, said he had guessed, rather than understood, the drift of the arguments. The speakers appeared to be of opinion that the loss of heat by windows would be so great as to neutralise the advantage of thickened walls. It was a question of degree, of calculation, of volume. The larger the windows the thicker should be the walls. The fundamental idea was that the surrounding mass should be so ample and sufficient that the heating of a wall should not depend upon the withdrawal from the inmates of any portion of their animal heat. He hoped that his remarks would not be misunderstood by his ancient colleague and general secretary at Vienna, the Chevalier Von Gruber.

Sur l'Emploie des Fondations sur Pilotis pour les Habitations.

PAR

le Dr. P. J. H. Cuypers,
Architecte des Musées Nationaux, Amsterdam.

I. Les constructions datant du moyen-âge dans les villes construites dans un terrain marécageux, comme Amsterdam et Rotterdam, sont toutes bâtis sur pilotis. De ces temps on augmentait la résistance du sol tourbeux en enfonçant grand nombre de pilotis long de quatre mètres environ, tout côte à côte. Toute cette masse de bois était enfoncée jusqu'au dessous du niveau de l'eau; sa surface était beaucoup plus étandue que la largeur des fondations en maçonnerie. L'élasticité des couches tourbeuses comprimées par les bois de sapin, agissant dans un même sens que la force de l'eau dans lequel ces bois sont enfoncés, constituaient la résistance pour la fondation des constructions.

À mesure que les moyens méchaniques, servant à forcer les bois de sapin à entrer dans le sol, se sont développés, on a augmenté la longueur des bois, pour atteindre plus de résistance. Dans beaucoup d'endroits on est parvenu à un systême (reposant) basé sur un principe plus sur:

restreindre le nombre des pilotis, augmenter leur force en choisissant des bois de plus forte dimension, les enfoncer en terre jusque dans les couches très résistantes de sable pur, ou mêlé d'argile. Dans ces conditions il est possible de calculer la force résistante de chaque arbre qu'on vient d'enfoncer, puisque le poids du marteau, la vitesse avec laquelle il frappe la tête de l'arbre (pilotis) et le poids de l'arbre sont connus; et après chaque coup l'on mesure l'avancement en terre. Dans certains cas la résistance d'un arbre peut être évaluée à dix-huit mille kilogrammes. Dans certains endroits la couche originelle de sable déposé par la mer ou les fleuves, est si profonde que les plus forts arbres (de vingt mètres par exemple), n'atteignent point ces couches résistantes.

II. Le niveau de l'eau qui enpreigne le sol, est dans tous les terrains tourbeux (généralement des polders drainés par les moulins à vent ou pompes à vapeur) assez constant de hauteur. On a retrouvé des fondations en pilotis d'anciens monuments ou des ramparts des villes après plus de deux ou trois cents ans, qui étaient restées tout à fait intactes quant à leur résistance. Le bois s'était noirci, et était aussi dur que le métal.

Dans les "polders" qui existent déjà plusieurs siècles, les terrains se sont retrécis, et on a dû abaisser le niveau constant de l'eau. Des suites très funestes se sont déclarées dans les monuments datant de plusieurs siècles. Les fondations ne résistaient plus, et des crévaces se montraient de tout côtés. L'examen des pilotis démontrait que le bois avait été à sec, et était donc pourri en peu de temps. On a pu y remédier dans quelques cas, en coupant les bouts des pilotis pourris et en introduisant par morceaux, de la maçonnerie entre les vieux murs et la fondation en bois d'autant plus profonde.

III. On pose les pilotis en moyenne à une distance de 0.50 m. mesurée sur les centres. En coupant et égalisant les têtes des arbres enfoncés on ménage un tenon qui entre dans les traverses (holl. = *kespen*), destinées à supporter le plancher en bois (épaisseur de 0.08 à 0.12 M, en sapin ou en chêne là ou le poids de la construction sera très grande). Les différentes planches sont posées à une distance de 1 à 2 centimètre pour leur permettre de se dilater sous l'influence de l'eau, sans exercer une pression dangereuse sur les moyens d'assemblages surtout des planches extérieures.

IV. Les ingénieurs du "Waterstaat" (Ponts et chaussées, etc.), et de chemins de fer de l'état ont quelquesfois coulés des blocs immenses de béton en ciment, comme moyen de relier les têtes des pilotis, et en même temps comme fondations pour les maçonneries. Les pilotis avancent dans ce cas sur un mêtre en hauteur dans la masse de béton, qui a deux mètre de hauteur; comme ces fondations sont exposées à une très grande pression par la structure superposée (des piles de ponts en fer, etc.), il faut pouvoir conter absoluement sur la cohésion du bloc de béton, afin qu'il n'y pas de danger qu'il se rompe, en plusieurs pièces; un écroulement de l'œuvre entière en pourrait être la suite funeste.

Aussi en vue de quelques désastres qui se font produits dans des constructions exécutées d'après ce systême dans des terrains marécageux

et très peu résistants, les architectes n'ont pas imité ce systême qui n'est efficace, que dans des terrains sablonneux et argileux, formés par les couches des grands fleuves ; dans ces conditions ou peut éviter avec le pilotis des constructions pneumatiques bien plus couteuses.

Quoique le béton pourait fournir une bonne fondation pour les caves, qui serait imperméable à l'eau du sol, on ne l'employe pas dans ce but, craignant les fissures, dans les terrains marécageux ; les fondations entièrement construites en bois sont absoluement nécessaires dans ces circonstances, pour porter la maçonnerie.

V. Depuis deux siècles la coutûme d'habiter les caves, de les destiner pour les comptoirs et bureaux des commerçants, pour des ateliers de peintres et verriers, de menuisiers, etc., s'était extrêmement répandue dans nos grandes villes, à cause du prix élevé des terrains et des fondations. Un grand nombre de la classe ouvrière vivaient dans de caves en grande partie sous-sol. Et comme les fondations n'avaient pas été executés avec assez de soin l'eau pénétrait pendant l'automne et l'hiver, souvent au dessus du pavé. Chaque soir et chaque matin ces habitants pompaient devant leur entrée cet eau, pour l'éloigner par les égouts, pour un certain temps du moins. Car chaque jour elle revenait de nouveau.

Depuis vingt ans les autorités communales, ont défendu d'habiter les sous-sols, et ceux qui les habitaient dans ce temps, devraient les quitter dans un espace de temps déterminé.

Quoique à présent les cas soient rares que les sous-terrains soient encore habités par des familles entières, pourtant on dispose généralement la cuisine et quelques autres pièces, qui sont habitées pendant le jour dans les sous-terrains. En tout cas il est d'une grande importance pour la salubrité des habitations, que les caves soient absoluement sêches. L'humidité des planchers et des murs ne ferait pas seulement pourir les bois, les meubles et les tapisseris, etc., dans ces sous-terrains, mais dans un pays aussi fièrreux, que le nôtre, les habitants sentiraient bientôt les suites funestes d'une demeure, où cette humidité se répandrait par tous les étages.

Les conditions suivantes s'imposent à la structure de nos caves, sur une fondation en pilotis.

1°. Comme le bois ne résiste pas à la décomposition, au dessus du niveau de l'eau, les murs en maçonnerie sont posés au dessous du niveau de l'eau le plus bas, qui se présente. Pendant l'exécution des maçonneries on tient le puit, dans lequel on travaille à sec par de pompes de différentes capacités.

2°. Pourque garantir le plancher de la cave, ou du souterrain, on peut le monter au dessus du niveau de l'eau dans de sol. Afin de guarantir les murs d'agir comme conducteurs de l'humidité, une partie comprise entre deux plans horizontaux : l'un en dessous du plancher intérieur, l'autre en dessus du sol environnant, est exécuté en chaud hydraulique, au ciment, ou à la chaud melangée de parties égales de ciment de tuffeau (pièrre de tuffe provenant des boids du Rhin, écrasée en poussière).

Les évaporations du sol sont écartées par des courants d'air introduits au dessous du plancher, passant sur une couche de sable couvrant le sol originaire.

3°. Dans le cas ordinaire, voulant économiser sur la hauteur de la construction, on est bien obligé de descendre le plancher du sous-terrain en dessous du niveau de l'eau. Il faut que le pavement, aussi bien que les murs, jusqu'en dessus du terrain environnant, soit parfaitement imperméable. Comme on ne construit en général, que des murs d'une dimension très faible, il faut gagner en qualité des briques et du mortier, ce qu'on perd de force par les faibles épaisseurs des murs environnants.

Trois à quatres couches de briques très bien cuites et dures, sans les moindres crévasses, posées dans un mortier de chaud et ciment, suffisent à résister à la pression de l'eau, qui ne vient d'une hauteur trop grande. Le dallage en marbre blanc ou en dalles de grés cérames est posé en dessus. De même les murs qui auront 0.34 m. à 0.45 m. d'épaisseur (tout suffisants pour porter trois étages), ne résistent pas à la pénétration de l'eau par les joints horizontaux des assises. Il est donc nécessaire de les courir à l'intérieur avec les mêmes couches de briques très dures, posées à plat (dans la plan vertical) jusqu'à la hauteur du niveau du terrain environnant). On prend bien soin de poser les briques en couches successives de manière que les joints soient toujours couverts par les couches supérieurs.

Mais comment supporter les dallages dans un terrain aussi marécageux ?

(α.) Quand le bâtiment possède dans sa fondation plusieurs murs parallèls peu distancés, la construction de voûtes cilindriques est facille et préferable. Le peu de hauteur nécessaire pour la voûte ne causera pas de difficultó dans le niveau du sous-terrain. Sur toute la superficie de la voûte ou coule du beton, où l'on remplit les profondeurs en maçonnerie afin d'égaliser la surface dans un plan horizontal, sur lequel trois ou quatre couches de briques avec le dallage forment un unsemble bien résistant à l'eau et les évaporations humides du sol. La surface extérieure des murs est couverte d'asphalte coulant, afin de prémunir les murs dans toute leur épaisseur contre la pression de l'eau.

(β.) Supposons que le sous-terrain ne possèdent que des pièces assez large, les fondations des murs restent bien espacées, de plus de 3 mètres. En ce cas les voutes cilindriques exigent une hauteur considérable sous le pavé. On préferre donc de continuer le plancher en bois sur toute la surface du bâtiment, afin de se passer des voûtes, et de pouvoir continuer la maçonnerie hydraulique des fondations, non seulement sous les murs, mais sous la surface entière de l'habitation. Tout ce bloc est exécuté dans les meilleurs matériaux, les briques les plus dures, etc.

Sous les couches de briques, sur le plancher en bois, une couche d'asphalte toute unie, guarantit d'avantage contre l'action de l'eau, surtout à cette profondeur où l'eau veut remonter avec force dans la maçonnerie.

Les différentes couches de briques font parfois remplacées par un beton au ciment, couvert d'une couche de ciment en mortier (moitié sable) d'une épaisseur de 3 centimètres au moins. Cette couche de ciment doit être continuée contre les murs jusqu'à la hauteur du terrain.

Les caves ainsi construites sont parfaitement saines; les influences de l'humidité du terrain, entièrement empreigné d'eau bourbeuse ne s'y font pas sentir du tout. Ces caves préservent toute la demeure de l'humidité dans les voisinages où le soir et la nuit des vapeurs désagréables puissent s'évaporer du sol.

4°. Si le cas présente qu'une habitation, construite il y a longtemps, ne possède pas de caves convenables; et que les fondations ne sont pas assez larges pour y installer encore la construction décrite plus haut; on exécute tout la cave dans une enveloppe de bois, de la forme d'un grand bac, posé à l'hauteur voulue, pendant qu'on tient l'eau pour ce temps à un niveau plus bas. Même sans fondations ces caves avec un grand massif de maçonnerie ne s'enfoncent pas dans le terrain marécageux, parceque le volume de l'eau remplacée est plus grand que le poid de toute la cave, comme elle a intérieurement un grand vide. Ces sortes de "caves flottantes" montent et baissent avec le niveau de l'eau entre les murs de la maison, et sont retenues par celles-ci dans leur direction.

VI.—Plusieurs habitations dans les villes de la Hollande sont situées sur les bords de l'eau, sans quai intermédiare. La salubrité de ces maisons ne diffère en aucune sorte des autres maisons des mêmes villes, pourvu que les fondations soient exécutées avec soin: car au fond, toutes les maisons de ces mêmes villes ont leurs fondations également sous la surface de l'eau, sans que les inhabitants en ressentent aucune suite désagreable ou malsaine.

Dans le bois de sapin et de chêne, sur dans les longs arbres de sapins, nous avons donc trouvé de matériaux d'une très grand valeur pour la construction dans tous les mauvais terrains. Le bois, qui dans la nature a comparativement si peu de résistance, ne pourrait être remplacé dans ces conditions par aucune autre espèce de matériaux.

Si la Hollande ne possède en général que peu de terrain solide à bâtir, puisque les provinces du Nord sont formées par un alluvium marécageux, elle a trouvé dans le bois de sapin, qui fournit des arbres d'une longueur assez considérable et de dimensions assez fortes, le moyen d'aller trouver le sol naturel à des profondeurs qui diffèrent de 4 à 28 mètres.

Une partie de la gare centrale à Amsterdam, notamment les piles extérieures de la charpente de la couverture sur les voies, a exigé des pilotis de 28 mètres de long sur une épaisseur de 38 à 40 centimètres à une mètre du tronc. La construction des fondations en maçonnerie de ce bâtiment, qui à 318 mètres de long sur 31 mètres de largeur a été établie sur un pilotis continu sur toute l'étendue du bâtiment. Les arbres sont enfoncés sur 50 centimètres d'axe en axe et assemblés par des madriers en chêne de 20 sur 30 centimètres et croisés par des longerinnes également en chêne de mêmes dimensions.

The Sanitation of Theatres.

BY

LENNOX BROWNE, F.R.C.S., Ed.

When the committee of this section did me the honour to permit me to embody in a paper the information I possessed of the condition of our theatres, I felt it was desirable, notwithstanding the long and extensive experience of them that I had, that a careful and detailed examination of the principal buildings should be effected in order that any statements I might find it my duty to make, should be founded on exact and precise information.

Through the courtesy of the lessees and managers, I have been able, in conjunction with my friend Mr. Ernest Turner, F.R.I.B.A., to inspect no less than 20 of our London theatres, besides a number in the provinces. I had, indeed, made application to 22 metropolitan lessees, but in two instances, instead of the ready assent accorded me by the majority, I was met by peremptory refusal, on the ground that the lessees could not permit their theatres to be inspected, except, to quote the exact words of the secretary of one, "by the authorised authorities."

As to one of these theatres, its pent-up situation, its age—over 30 years—and its manifold sanitary imperfections in the front part of the house, may be taken as sufficient reasons for the objections to inspection of the back; but with regard to the other, I had hoped to be able to describe it as a theatre which, being one of the most recently erected, might be accepted as a type of what a small comedy theatre should be, in the same way as one is able to point to another as a type of all that is best suited for the home of grand opera, and to a third as an almost ideal theatre for the requirements of light comic opera. However, during a visit to the front, when I occupied a seat in the stalls, on the prompt side, a strong whiff of carbolic acid which assailed my nostrils each time the door to that portion of the auditorium opened, indicated that the condition of the urinal in the adjacent lobby was far from perfect; and I further learned that another similar convenience opens directly into the pit; so one may assume that however well the building is constructed with an eye to the beautiful, and with all modern improvements for scenic display, the sanitary arrangements have not been equally successful in conception, or, it may be, in execution.

Of the 20 theatres which I did visit, it may be said at the outset that in many the arrangements, from a sanitary point of view, are the reverse of satisfactory; indeed, there is hardly one in which some fault may not be detected. But I am bound to testify that the defects are for the most part due to structural causes for which, when existing as part of an original plan, I am sure every member of this section will agree, that there is no excuse, although the blame should rest rather with the architect than with the proprietor. On the other hand, I have

the greatest pleasure in bearing witness that the managers have, with hardly an exception, endeavoured to overcome the difficulties of the situation by care and supervision. If they have not always been successful, it has been far less often from want of zeal on their part than from the ignorance and neglect characteristic of members of the lower branches of the theatrical profession, and especially of the working staff, who represent, for the most part, a low type of the artizan class. Against the results, however, of bad workmanship in the sanitary fittings, no amount of supervision of the employés is of much avail, and unfortunately in theatres, as in our own houses, instances of slip-shod and faulty work are by no means exceptional.

In the front of the house, among the audience, it is found that from the careless way in which sanitary appliances are used, they are not unfrequently getting out of order, or giving cause for complaint. With a large section of the public, and not by any means those occupying the cheaper seats, it would seem necessary to supply automatic flushers, or a staff of attendants specially to wait on them.

Most of our investigations were made on Sundays, for two reasons —1. Because it was the only day on which we could give the time necessary, and was the one least likely to interfere with the working of the theatre. 2. Because on that day, better than on a week day, one could gauge with a certain degree of accuracy, the care that was bestowed on the household arrangements generally; for as a straw may show which way the wind blows, so such small matters as leaving the slops unemptied till the Monday may be taken as a criterion of the ordinary practice in regard to sanitary matters.

Another indication of no small value of the sort of sanitary care that is taken at a theatre is afforded by the arrangements for the removal of dust and rubbish accumulation. At several, all dust is removed daily; at others, not only in small or in provincial theatres but in some of the largest London houses, heaps of refuse may be found, not at one, but in many corners.

I have not thought it necessary to make analyses of the air in these buildings, as I had at first intended, partly because this matter has been very carefully gone into by Angus-Smith and others, but chiefly because, given the cubic space, the number of occupants and of gas lights, and the amount, or rather, too often, the want of, ventilation, deductions can be drawn sufficiently convincing as to the state of the air, without calling in the aid of the analytical chemist.

Much has been written on the duty of theatre proprietors to afford protection from the risk of fire or of alarms of fire; but the London County Council, in its elaborate requirements in this direction, seems to have almost ignored the far more important subject of the health, not only of the actors and actresses, but also of the general public. I say "more important" advisedly, as there is ample evidence to show that the time when fires are most liable to occur in theatres, is not when the house is full, but within two or three hours after the audience and company have left the building; whereas if the sanitary arrangements are faulty, the danger is a constant one; and this danger to health,

while affecting the audience, must much more affect those employed behind the scenes, because they are compelled to be in the theatre for much longer periods, both for acting and rehearsals, and are there all the week round. Moreover, it is behind the scenes that insanitary conditions are to be found in their most objectionable form; and although from time to time more or less fitful interest has been excited by the rumour of a death or of a severe illness taken by some member of a London or a country company, any systematic sanitary investigation of that portion of the building in which the actor is specially engaged has not only been completely neglected, but its necessity has been practically overlooked. It is to this department, therefore, that I have made inquiry; and since my professional work for the last quarter of a century has brought me so directly into relation with members of the theatrical profession in all its branches, I can speak of the effect on their health with no uncertainty. Nor is this merely a question of affections of the throat, although they are bad enough and important enough to those with whom a sound throat is a *sine quâ non* of their vocation, for we find that the general health of the actor suffers to a very marked extent when he is compelled to breathe constantly the vitiated air of hot, crowded, unventilated, and ill-situated dressing-rooms; the lowered state of vitality predisposes him in a marked degree to bronchitis, pneumonia, phthisis, and diseases of the respiratory and circulatory organs generally, to dyspepsia, to so-called acute rheumatism—if rheumatism, and especially acute rheumatism, be not in itself a form of blood-poisoning—and to typhoid fever, deaths from which last are by no means uncommon among actors, especially in the case of members of touring companies. It is well known, also, that a craving for stimulants is set up by insanitary conditions of the respired air and surroundings of a man's work. Indeed alcohol is often asserted—it has never been proved—to be an antidote to the poison of an unsavoury atmosphere or occupation, and the statement is frequently made as an excuse for indulgence.

But it must not be supposed that because I deal with those mysterious parts of a theatre behind the curtain, that it is the employés who are the only sufferers from insanitary conditions in those situations. It must indeed have been in the experience of many that when the curtain has risen, or a scene has been changed, and especially when the stage has been opened up, a rush of air of charnel-like odour has blown into the house; while the occurrence of theatre headache, theatre diarrhœa, and even theatre sore-throat, is well recognised as the not infrequent morrow's payment for an evening's amusement. Moreover, anyone with the least knowledge of theatres must be aware that there are certain theatres throughout the kingdom which are hardly more or less than veritable death-traps.

Whenever I have conversed with a member of the theatrical profession on the subject I have always been told of one or other particular provincial theatre which was especially condemned. Not a few buildings have been particularised by more than one informant, and one or two are *always* mentioned as prominently insanitary. It is, however, almost impossible for the actor to attack this mischief because he belongs to a

profession in which supply is in excess of demand, and it is even difficult for a manager. In one case with which I am acquainted, the London manager of a company, a member of which died from typhoid fever taken in a provincial theatre, was advised by his lawyer not to insist on legal proceedings as it would greatly prejudice his having a date given him should he again desire to visit that town, and this prejudice might probably be shared by the managers of other provincial theatres who were conscious of similar sanitary shortcomings and dangers to health.*

In this connexion I may mention a case which happened in my own experience, and which throws a peculiar light on the legal view taken of our efforts to prevent disease. A young lady, who had on several occasions been under my care for attacks of sore throat of an undoubted sewer-gas type, while filling an engagement in a London theatre was directed by her manager under the terms of her agreement to play at a certain theatre in the kingdom notorious as a source of typhoid. On learning the destination of my patient I conceived it my duty to warn her of the danger to which, as one specially susceptible to the effects of foul air, she would be exposed, and I, at request, made an affidavit to that effect. The lady used my advice as a plea to release of the engagement, but when my declaration was read to one of the judges of the High Court before whom the case came, he remarked that he did not see that a medical man was called upon to give an opinion of that kind until his patient had actually suffered. Had I been examined on my affidavit I should have ventured to point out to his Lordship that the efforts of a doctor to prevent disease offer more probable chances of success than do our attempts to cure it when manifested, just the same as the best lawyer is not he who gains the largest number of successful verdicts but he who, recognising the uncertainty of the law, settles the most cases without recourse to a trial in court.

I am quite aware that in all probability my statement that an abnormally large proportion of theatrical ill-health is due to insanitation will be received with incredulity by the public, and met by opposition from the managers; such is, however, my sober conviction, and not only so, for there are certain houses, not only in the provinces, but in the metropolis, from which I am almost certain to receive as patients members of the profession who in other engagements enjoy fair health.

To come now to a consideration of the actual state of affairs existing in our theatres, I would deal first with the question of their *situation*; and this has such a strong bearing upon the construction of the building in reference to proper sanitation that it merits our most careful consideration. How many of our theatres can claim perfect isolation? But few, and only those of quite recent erection; but without isolation it is well-nigh impossible either that the risk of fire, when arising

* In the case of touring companies in the provinces there is, of course, the added danger of sanitary imperfections in the lodgings occupied; since, owing to prejudice, it is difficult in many towns to procure accommodation of the better class. Moreover, the fatigue of Sunday travelling and of constant rehearsals is apt to make individuals more "receptive" of malign influences on the health.

in the theatre, can be limited to that building, or that conflagration from contiguity can be insured against.

Nor can there be thorough, or indeed sufficient, ventilation without isolation; for where there is—as exists in several cases—some sort of open space on one or other side of the building, the changed "air" is very far from "fresh," even when mechanical aids are employed; indeed, in very many instances it is actually vitiated, being drawn from some narrow slum or back court, used, may be, as a urinal, or lumbered up with disused stage properties. I am aware, of course, of the difficulties which have existed and still exist in the way of theatres being so perfectly isolated as will be admitted by modern hygienists to be necessary. Theatres to be successful must occupy central positions, and sites in such localities are difficult and expensive to obtain. Hence we find that a large number of our theatres have been erected in pieces of ground which must have taxed the ingenuity of the architect to a considerable extent in the preparation of his plans, and in at least three instances the difficulty of available site has been met by placing the theatres below the level of the street altogether, and in such a situation as to render efficient sanitation well nigh a matter of impossibility. In an above-ground theatre, however hemmed in it may be by other buildings, space for dressing and retiring rooms may be adequate or not, and windows are at least feasible, though they are by no means the rule; but in underground theatres and in rooms built under the stage windows are either altogether absent or are of the order of a transparent ceiling, and of no practical value for ventilation. Moreover, in underground theatres there must be a constant difficulty with the drainage, where, as has actually been the case, the drains are placed at a lower level than the main sewer. It is fair to report that in two such buildings of this class attempts more or less successful have been made to remedy this grave defect, a defect one would hardly expect to find in theatres built so recently, for one dates from 1882 the other from 1874; this last was reconstructed entirely for causes of sanitation in 1883. It is difficult to acquit the architect of blame in the first instance, for with all respect to the profession, I do not think he should have consented to prepare plans on such lines. Even now such an event as percolation of sewage from an old brick drain is not an unknown occurrence under the stage in one of these reconstructed sub-soil theatres. To demonstrate still further the difficulties met with in theatres built in cramped positions, I found it not an unusual position for waterclosets to be in dressing-rooms or in hot lobbies (80° F. on Sunday morning) into which dressing-rooms opened, the only means of ventilation for the closets was into these rooms (Diagrams 7, 8, and 10).* It is well nigh impossible to conceive that these arrangements were part of the original plans. While on this subject I would point to another accompaniment which I consider objectionable in underground as in all theatres, and that is having other buildings, as restaurants, erected over or in close contiguity to them.

* The diagrams referred to are given in Mr. Ernest Turner's paper which follows this one.

Applying this matter of situation to country theatres, it may be added that not only is there less excuse on account of cost for non-isolation, but that, as a matter of fact, very many of such buildings—full of other sanitary defects—cannot have this particular fault of over-crowding charged against them.

Accommodation.—Theatres which have been built during the last 10 years show improvements in the dressing-room accommodation (Diagrams 1 and 2) over that provided in the older theatres; but much still remains to be done, and in only one can the arrangement be considered absolutely satisfactory (Diagram 1). In the very old theatres, especially the large ones, there are long underground rooms without either light or water. In one of the oldest we found a room employed for office purposes placed over a vault in which were three waterclosets used by the working staff, all out of order, and in two of them the pans were full. At this theatre the fire-watch is the most complete in London, so that it is guarded against the only possibility of improving its sanitary defects; if it should take fire it is to be hoped that it will be empty, as there would be very little chance for its safety, and with its wooden staircases and numerous passages, not much for those engaged on the stage. In most theatres, even in some of the larger houses, there is an absence of a master key by which all the rooms could be opened without delay in case of fire. This defect does not exist in the case of two of the large houses visited. At one theatre we were informed that we could not enter several of the rooms occupied by principals because the rooms were locked and the keys taken away by their occupants. Such a statement can, however, be hardly credited.

While on this point of fire-watch it may be remarked that at not a few theatres the fireman is a sort of ornamental appendage to the front of the house, and very ready to call a cab or run a message. I commend this circumstance to the attention of fire insurance managers and to the successor of Captain Shaw.

In some five or six of the later built or reconstructed houses, there is good dressing-room accommodation, with sufficient air-space, ventilation, and light for the occupants. In some there is enforced permanent window and over door ventilation (Diagram 3), in others mechanical means are employed. In hardly any of the theatres of more than five years' duration is there a constant supply of water to be found in the dressing-rooms; on the other hand, where arrangements for running water obtain, there also the basins were of good class and well-trapped.

But in another class of houses things are not in so satisfactory a condition. I refer to those places which were originally not intended for theatres, but were built as music or lecture halls, and have been since adapted to the purposes of comic opera or spectacular burlesque. The original requirements in regard to dressing-rooms were naturally not at all on a par with those of a theatre. All that was needed were a few small rooms to be occupied by one or two artistes at a time who came in "turn" and would take the room vacated by those who had preceded them; consequently, when it was proposed to give spectacular entertainments the accommodation was found to be

most incomplete, and where additional houses could not be acquired, room was found below the stage.

In one such theatre we discovered 15 or 16 rooms below the stage, some even at a second level, and in only three of these were there windows. In the case of two, I was informed, and for all I know in that of the third, these windows were of necessity kept shut because they opened into areas with grating coverings through which the staff and others were in the habit of urinating. One of these rooms measured 38′ × 7′ × 7′ 9″ (Diagram 4), and was occupied by 16 to 18 ladies, each of whom, therefore, supposing there were only 16 occupants, had barely over 130 cubic feet of space, enough to supply them with air, if it was originally pure for about 2½ minutes according to the estimate of 3,000 per hour; and the space given for each individual, which should include that for dressing-table, dresses, &c., would be something like 16 square feet, or an area of 4 feet by 4.

Another instance of imperfect accommodation is represented by the theatre originally constructed for the purposes of comedy with a small company, but later employed for production of comic opera with a company four, or it may be six, times as numerous. In this description of theatre, adapted from buildings not originally intended for dramatic representation, we found, and I regret to say in many others, closets either in or close to the rooms (Diagrams 5, 6, 7, 8, 9, and 10), separated in some instances only by a partition of match-boarding (Diagram 6).

The old pan closet has been retained even in one house otherwise well nigh perfect, and a closet much advertised was repeatedly pointed out to us as the acme of completeness, albeit it is one which sanitarians generally would consider far behind the requirements of to-day. In one theatre a w.c. adjoined the dressing-room of a principal artist, and the fatal error was permitted of having the closet disused, though the cistern for the drinking water and a sink were situated in the same cabinet. Nor was it at all uncommon, when we came on a closet particularly badly situated, to be told, as a virtue of management, that it had long been disused. Needless to say, no one in these cases had thought it necessary to cut off connexion. Nor are the w.c.'s in the front of the house any better than, or, for the most part as good, as the majority of those at the back, and for the defects in their situation and for the utter absence of all ventilation the architects must surely be held responsible. In some instances it would appear as if no arrangement for such necessaries had been part of their original design, for we found them literally planted in such positions that the only source for fresh air (save the mark) or for exit of foul was an adjacent cloak-room, lobby, refreshment-room, or even a portion of the auditorium. That this statement is not exaggerated is proved by the plentiful dissemination of the odour of disinfectants, and, in fact, whenever a disinfectant is to be smelt, it may be accepted that it represents, not the antidote, but the disguise of a poison it has attempted to conceal by a more vigorous attack on our olfactory sense.

On the programmes of a newly reconstructed theatre the particular form of disinfectant employed in the building is naively printed under the advertisement of the special musical organ used. In another, in

which we found a w.c. in the ladies' cloak-room ventilating onto the staircase, and a second onto the passage lobby to the stalls, we were met in all parts of the building by a printed certificate of a recent date, and signed by a gentleman who added "F.S.I." to his name that "the "sanitary condition before and behind the curtain was (in his opinion) "*satisfactory*."

I have alluded to an instance in which a w.c. behind the stage was contiguous to the flue of a restaurant under which the theatre was built. In another theatre a closet in the front of the house, which was indeed a part of the ladies' cloak-room, was similarly overheated, and no means of cooling existed except by opening the door which led to the passage for occupants of the boxes and stalls. The accommodation of this nature, even to Royal boxes, in more than one instance is faulty.

So much for the closets. I regret to say that the condition, and especially the situation of the urinals behind the stage, are even worse. Sometimes there are none whatever for the working staff, so that accommodation is often sought for either against the walls and down the areas of the theatres themselves or at the adjoining "public."

In one of the earlier theatres that we visited, where, as was well known, many members of the company had been recently ill, we found a stand-up urinal situated beneath the stage at the back and centre. Openings in the stage flooring really exposed the urinal to view, and these openings were in point of fact the main sources for its ventilation. We should have hesitated to mention a circumstance so damnatory, and, as it might appear, so identifying of a particular theatre, were it an isolated example, but I regret to say that we found the same condition with but slight, and in no sense extenuating variations, in several other houses.

In one, the urinal of the working staff was in the corner of the stage itself; the ventilation was, however, not entirely on to the stage but into a fire-escape shaft, whence windows opened on to each half-landing of the staircase used by the company; how much of the malodorous air of this urinal was drawn from these windows into the dressing-rooms and how much driven on to the stage by down draft of cold would be a nice (?) point to determine.

Incidentally reference has been made to the extremely deficient ventilation of the working portion of most theatres. It is a pleasure to state that at two houses, where very large numbers of dancers, &c., are gathered in one room and have to make many changes of dress, the construction of the rooms and the ventilation—which is of a permanent character—are well nigh as perfect as they can be. In the smaller rooms of these theatres occupied by the "principal," especially when they are foreigners, every inlet for fresh or outlet for used air is carefully and almost hermetically blocked.

Lighting.—The electric light is now largely used behind the stage, but is often supplemented by gas burners because the artistes—quite erroneously, as is proved by their absence in the Royal English Opera House and the Savoy—insist that the electric current cannot supply sufficient heat for their purposes of "make up."

most incomplete, and where additional houses could not be acquired, room was found below the stage.

In one such theatre we discovered 15 or 16 rooms below the stage, some even at a second level, and in only three of these were there windows. In the case of two, I was informed, and for all I know in that of the third, these windows were of necessity kept shut because they opened into areas with grating coverings through which the staff and others were in the habit of urinating. One of these rooms measured 38′ × 7′ × 7′ 9″ (Diagram 4), and was occupied by 16 to 18 ladies, each of whom, therefore, supposing there were only 16 occupants, had barely over 130 cubic feet of space, enough to supply them with air, if it was originally pure for about 2½ minutes according to the estimate of 3,000 per hour; and the space given for each individual, which should include that for dressing-table, dresses, &c., would be something like 16 square feet, or an area of 4 feet by 4.

Another instance of imperfect accommodation is represented by the theatre originally constructed for the purposes of comedy with a small company, but later employed for production of comic opera with a company four, or it may be six, times as numerous. In this description of theatre, adapted from buildings not originally intended for dramatic representation, we found, and I regret to say in many others, closets either in or close to the rooms (Diagrams 5, 6, 7, 8, 9, and 10), separated in some instances only by a partition of match-boarding (Diagram 6).

The old pan closet has been retained even in one house otherwise well nigh perfect, and a closet much advertised was repeatedly pointed out to us as the acme of completeness, albeit it is one which sanitarians generally would consider far behind the requirements of to-day. In one theatre a w.c. adjoined the dressing-room of a principal artist, and the fatal error was permitted of having the closet disused, though the cistern for the drinking water and a sink were situated in the same cabinet. Nor was it at all uncommon, when we came on a closet particularly badly situated, to be told, as a virtue of management, that it had long been disused. Needless to say, no one in these cases had thought it necessary to cut off connexion. Nor are the w.c.'s in the front of the house any better than, or, for the most part as good, as the majority of those at the back, and for the defects in their situation and for the utter absence of all ventilation the architects must surely be held responsible. In some instances it would appear as if no arrangement for such necessaries had been part of their original design, for we found them literally planted in such positions that the only source for fresh air (save the mark) or for exit of foul was an adjacent cloak-room, lobby, refreshment-room, or even a portion of the auditorium. That this statement is not exaggerated is proved by the plentiful dissemination of the odour of disinfectants, and, in fact, whenever a disinfectant is to be smelt, it may be accepted that it represents, not the antidote, but the disguise of a poison it has attempted to conceal by a more vigorous attack on our olfactory sense.

On the programmes of a newly reconstructed theatre the particular form of disinfectant employed in the building is naively printed under the advertisement of the special musical organ used. In another, in

which we found a w.c. in the ladies' cloak-room ventilating onto the staircase, and a second onto the passage lobby to the stalls, we were met in all parts of the building by a printed certificate of a recent date, and signed by a gentleman who added "F.S.I." to his name that "the "sanitary condition before and behind the curtain was (in his opinion) "*satisfactory*."

I have alluded to an instance in which a w.c. behind the stage was contiguous to the flue of a restaurant under which the theatre was built. In another theatre a closet in the front of the house, which was indeed a part of the ladies' cloak-room, was similarly overheated, and no means of cooling existed except by opening the door which led to the passage for occupants of the boxes and stalls. The accommodation of this nature, even to Royal boxes, in more than one instance is faulty.

So much for the closets. I regret to say that the condition, and especially the situation of the urinals behind the stage, are even worse. Sometimes there are none whatever for the working staff, so that accommodation is often sought for either against the walls and down the areas of the theatres themselves or at the adjoining "public."

In one of the earlier theatres that we visited, where, as was well known, many members of the company had been recently ill, we found a stand-up urinal situated beneath the stage at the back and centre. Openings in the stage flooring really exposed the urinal to view, and these openings were in point of fact the main sources for its ventilation. We should have hesitated to mention a circumstance so damnatory, and, as it might appear, so identifying of a particular theatre, were it an isolated example, but I regret to say that we found the same condition with but slight, and in no sense extenuating variations, in several other houses.

In one, the urinal of the working staff was in the corner of the stage itself; the ventilation was, however, not entirely on to the stage but into a fire-escape shaft, whence windows opened on to each half-landing of the staircase used by the company; how much of the malodorous air of this urinal was drawn from these windows into the dressing-rooms and how much driven on to the stage by down draft of cold would be a nice (?) point to determine.

Incidentally reference has been made to the extremely deficient ventilation of the working portion of most theatres. It is a pleasure to state that at two houses, where very large numbers of dancers, &c., are gathered in one room and have to make many changes of dress, the construction of the rooms and the ventilation—which is of a permanent character—are well nigh as perfect as they can be. In the smaller rooms of these theatres occupied by the "principal," especially when they are foreigners, every inlet for fresh or outlet for used air is carefully and almost hermetically blocked.

Lighting.—The electric light is now largely used behind the stage, but is often supplemented by gas burners because the artistes—quite erroneously, as is proved by their absence in the Royal English Opera House and the Savoy—insist that the electric current cannot supply sufficient heat for their purposes of "make up."

Heating.—The absence of ventilation entails such an excessive temperature that the thought of any method of warming seems hardly to have occupied the mind of the theatrical architect of the past, and except in the green room, it is rare to find a fireplace in use in rooms behind the scenes, or even to find one at all. An excellent coil arrangement exists in one of the most recently built houses.

The foregoing remarks represent in almost the fewest possible words the outcome of our inspection; it is needless to add that a paper could have been written on any one of the many headings considered, and almost on any one of the theatres, which should have occupied the limit permitted to the whole. But, in point of fact, I have been able to take but a general survey, and perhaps this is as well in an opening paper, and I have therefore asked Mr. Ernest Turner to utilize a large quantity of the information we obtained as a separate contribution to this discussion, and have had pleasure in placing at his disposal the rough sketch plans made by me at our visits for the purpose of diagrammatic illustration.

I fear that my communication will be considered as representing a pessimistic view. From the aspect of the doctor it could hardly be otherwise; for in making a diagnosis one has rather to take note of what is diseased than of what is sound. But in making a prognosis one is permitted to place in the balance both the favourable and the unfavourable; and, so doing, I venture to prophesy a greatly improved sanitary condition of our theatres in the near future. Nor would I wish it to go forth that in my opinion the sanitation of theatres is any worse, except that large numbers of persons are occupied therein for a constancy of employment, than is that of concert halls, conventicles, or institutions for the purpose of Christian association.

In conclusion, I may say that one of the conditions which I imposed on myself when undertaking this inquiry, was that my remarks should be as impersonal as possible. While, therefore, I have been careful not to actually identify any theatre whose arrangements I have felt it my duty to condemn, I have been obliged to abstain from naming those possessing characteristics which it has been a pleasure to commend.

Diagrams Illustrative of the Sanitation of Theatres.

BY

Ernest Turner, F.R.I.B.A., Architect to the Royal Academy of Music.

The diagrams exhibited, 12 in number, are complementary to Mr. Lennox Browne's paper, and, although they are not measured drawings to scale, but only proximate representations as to size, they are accurate in so far as they illustrate types of good and bad arrangements at the theatres visited.

In considering the matter fairly, it must be borne in mind that the buildings represented are of very different dates, and the strong contrast

which is presented between those of earlier and those of later date marks well the progress of sanitation, and will, I think, lead to the conclusion that many of the older theatres require their sanitary arrangements to be remodelled, amounting, in some instances, to an entire reconstruction of a portion of the buildings.

Diagrams Nos. 1, 2, and 3 illustrate three arrangements of dressing-rooms in relation to corridors and conveniences, the first two constituting part of the original plan of the theatre, the third, the arrangement in an added house.

No. 1 represents the dressing-rooms on each floor in one of the newest London theatres, and is in every way well planned. The corridor is well lighted, and cross ventilation is practicable when desired;

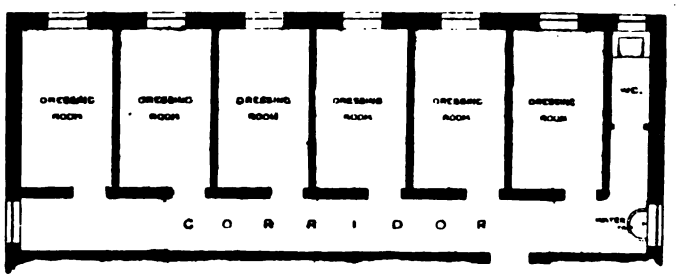


FIG. 1.

the closet is well placed; the rooms are sufficiently large and lofty and have good windows opening to the public street. The well-arranged presses and lockers with which the rooms are fitted, affording a place for everything and security against loss, render it practicable to leave the doors of the rooms open when unoccupied, although, strange to say, advantage is not taken of such facility in the very theatre under consideration.

This latter point appears to me to be worth more consideration than it generally receives, both on the score of access for the fireman and of air flushing the apartments.

There are in this theatre several floors of dressing-rooms similarly arranged; and a hydraulic lift, which travels at high speed, conveys the performers to and from the stage. The perfection which has been attained in the construction and mechanism of lifts or elevators may be the key to the problem of providing adequate dressing-room accommodation upon what might otherwise appear to be inadequate sites.

No. 2.—Here the closets are placed at the ends of the corridors, and one over the other, not an unusual arrangement in modern theatres, but necessitating at least a good air shaft, which is not generally to be found, but does exist in this house.

In many theatres it is difficult to believe that the closets formed part of the original plan of the architect, indeed, to the professional eye, there is strong evidence that they have been added as afterthoughts.

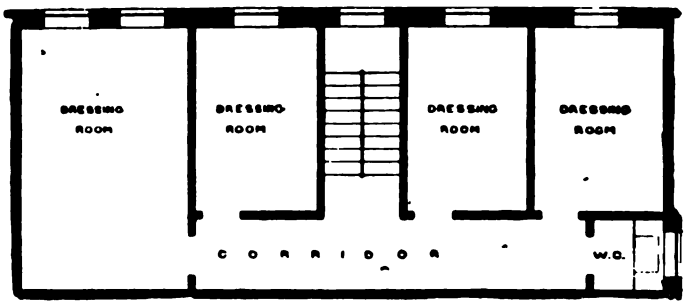


Fig. 2.

No. 3.—Although the dressing-rooms here are good, the corridor is only lighted by artificial light, and it is ill-ventilated. It may be thought that, as the buildings are chiefly occupied at night, the absence of windows in the corridors is of little importance. A visit to the theatres, and the difference that will be observed between the cleanliness and sweetness of corridors lighted naturally and artificially will soon

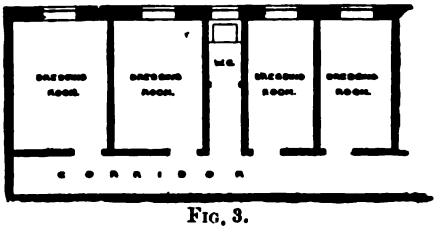


Fig. 3.

dispel such illusion. And whilst on the subject of cleanliness in corridors and elsewhere, let me draw attention to the many advantages which arise from the use of glazed bricks as internal wall surfaces. In a few of the modern theatres they have been freely used with most satisfactory results.

Nos. 4 and 5 represent two of the worst dressing-rooms seen by us. No. 4 is occupied by 16 to 18 girls, who have to remain the greater portion of the evening in this room, which is under the stage, and

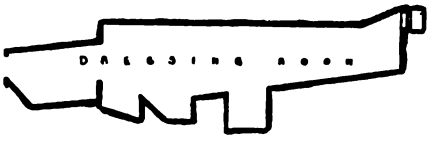


Fig. 4.

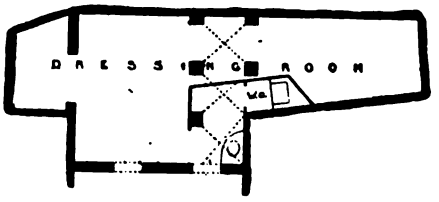


Fig. 5.

practically unventilated. Having regard to the small amount of cubic space, the number of lights and occupants, and the impossibility of air

renewal, such an arrangement must be condemned as highly insanitary. Indeed, it is nothing short of gross cruelty to compel human beings to occupy such a den.

No. 5 is another cellar dressing-room, in the same theatre, with piers and vaulted roof, almost, if not quite, as bad as the last, and has, in addition, a closet and sink in objectionable proximity. The legal definition of a "cellar dwelling" is "an underground room in which "any person passes the night," and it is illegal to occupy such room unless certain regulations as to height from floor to ceiling, size and position of window, means of ventilation, &c., are complied with. These cellar dressing-rooms do not in any way comply with such regulations; but it appears that they may be occupied from 6 o'clock until 12, although occupation from 12 to 6 would be illegal.

Turning for a moment from examples of bad arrangement, it is a pleasure to be able to speak of two metropolitan theatres where, in some of the dressing-rooms used in common by a large number of dancers and supers, there is not only ample cubic space in the large and lofty rooms, but excellent natural and artificial ventilation.

Diagrams Nos. 6, 7, 8, 9, and 10 illustrate faulty arrangements of closets in relation to dressing-rooms.

In No. 6, which is a portion of an added house, the closets on two stories are practically portions of the dressing-rooms, enclosed by match-boarding partitions only. One, which was very defective and offensive,

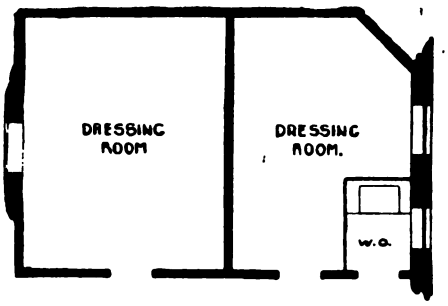


FIG. 6.

was for the accommodation of about 30 people, and was partitioned off from a dressing-room 15 ft. × 10 ft. × 8 ft. high, occupied by three ladies. This arrangement reminds me of one lately found *in* the kitchen of an Italian restaurant in London, where the only convenience was enclosed by a canvas screen.

No. 7 shows an exceedingly bad arrangement of unventilated lobby, dressing-rooms, and closet. The air of the latter pervades these rooms and the lobby, and to intensify the evil, the heat from the boilers of an adjoining restaurant renders this unsavoury corner almost unbearable. It is true that each dressing-room has a window, but each window opens into a very deep and narrow area common to the restaurant above, and covered by a grating with small openings.

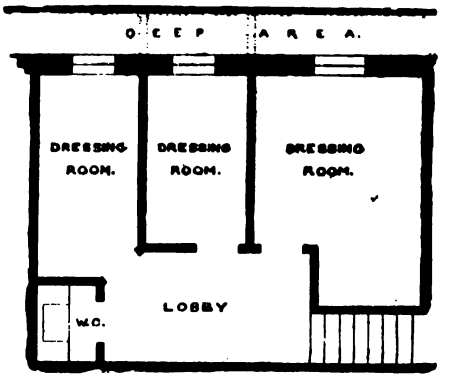


Fig. 7.

No. 8 illustrates an underground closet in connexion with dressing-rooms (occupied by four of the principal gentlemen of the company) and with staircase close to the stage; being without window to the open air, it necessarily pollutes the atmosphere of adjacent room, staircase,

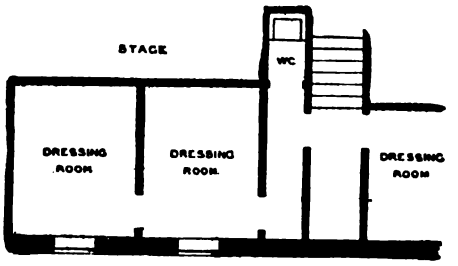


Fig. 8.

and lobby, and all the more so since, with the idea of ventilation, a small square opening has been made through the wall on to the staircase in question.

No. 9 shows another closet in the same theatre, again without window, open to the staircase and adjoining dressing-room, and situated under the cistern for drinking water, the draw off being in the

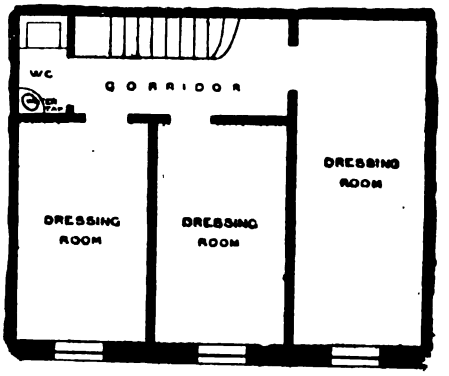


Fig. 9.

closet itself. This place, I was told, had been found so objectionable that, at the request of the occupant of the dressing-room, orders had been given that it was not to be used. No means had, however, been taken to cut off the connexion with the drain, and I need not explain to this section the probable result of the order.

No. 10 is an arrangement of closets good enough if they had windows opening into the open air, instead of, as is the fact, being

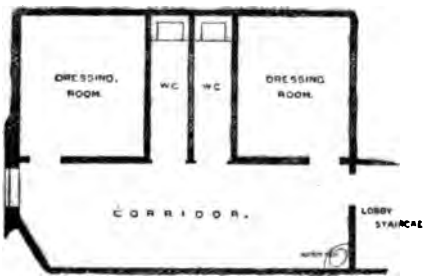


Fig. 10.

without windows, and being open to the internal lobby over the door-heads.

No. 11 illustrates an unventilated closet in relation to a private box, showing what luxury is provided for those who can afford to pay for it;

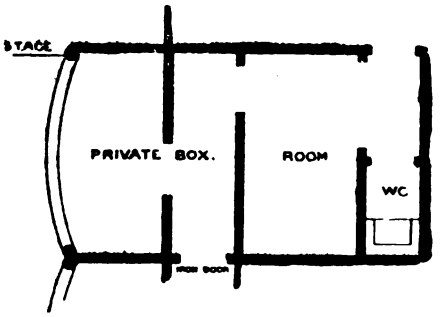


Fig. 11.

and No. 12, the arrangement of a ladies' cloak-room, this last being typical rather than unique.

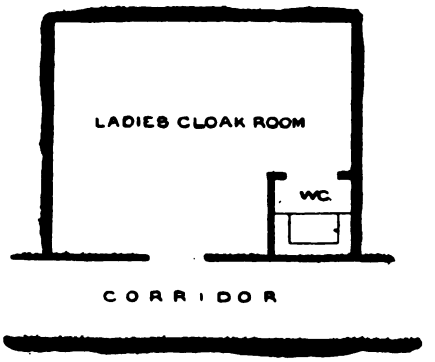


Fig. 12.

In these few brief notes I have put some of the facts plainly before you, and I have confined my remarks almost entirely to the *plan* of the apartments mentioned, the plan of the building being, from an architect's point of view, of primary importance, for, if this be imperfect, no subsequent so-called "sanitary engineering," however skilful, can make amends for the original defect.

I do not for a moment mean to imply that the introduction of modern appliances, good plumbers' work, and well-laid and ventilated drains, would not do much to improve the sanitary condition of many theatres; but, on the other hand, I feel sure that you will agree with me that many of the rooms are, from their position and surroundings, totally unfit for the uses they are put to, and that they call for abolition, re-arrangement, or re-construction.

With respect to overcrowding, one great difficulty seems to be that theatres built to accommodate small comedy companies are subsequently occupied by large companies playing burlesque and comic opera. It is obvious that whatever skill the architect may display in the original plan, and whatever control may be exercised in the official examination and approval thereof, are, in these circumstances, rendered nugatory.

In questions affecting the health of the community at large, or any particular sections thereof, Acts of Parliament and regulations are, doubtless, to a certain extent, necessary; but still more useful will be a widespread knowledge of hygiene—an appreciation of its economy and of the benefits it confers upon those who follow its teachings—a knowledge which it is the main object of this Congress in its various sections to promote.

It should be needless to say that it is solely in this spirit that my colleague and I have conducted these somewhat delicate investigations. We gratefully recognise in the general consent of managers to our request to be allowed to visit their theatres, a desire on their part to march with the sanitary enlightment of our days, and on this account, as well as from the evidences of improved construction in each new theatre which is opened, we may look hopefully to the future. We can but trust that this discussion will hasten the new era, and that the work of this section, and of the whole Congress, will help to bring the world at large to recognise that good sanitation, so long obstructed and regarded as a bore, is indeed a boon and a blessing free of hindrance or disguise.

DISCUSSION.

Dr. Allan (Public Health Medical Society) referred to the case of a theatre recently built, where, next to the box-office, and, doubtless, in close proximity to the place where the cakes and the refreshments were placed, the watercloset and lavatory were situated. In the Bayreuth Theatre they had an excellent model to follow. It stood clear in its own space of ground, and all conveniences and other buildings were quite clear of the main buildings. There was great room for improvement in concert halls, and in some of the clubs. The ventilation in most of them was bad, and they would do well to follow the example of Dr. Lennox Browne and Mr. Ernest Turner, and track down the evils to their source and origin.

If the London County Council would add to its self-imposed censorship on the morality of theatres and music halls the duty of securing proper sanitary arrangements, and would insist on a clear space around the main building in all such cases, they would be really benefiting the community.

Mr. Walter Emden complained that while in foreign countries theatres and places of amusement were subsidised, in England they were penalised, and everybody tried to stop them. He thought those who expended their money in the business were as much entitled to the benefit of the protection of the law as other members of the community, and that they should not be harassed. He contended that isolation was not absolutely necessary. A more scientific treatment of sites would enable architects to obtain all the desirable security without insisting upon the necessity of isolation. With regard to the portions of some theatres below the ground level, the speaker contended that the placing of one tier underground was not only not injurious, but was positively advantageous. If a panic of fire occurred in a theatre it would surely be better to have to come down two staircases than four. A better division could hardly be found than commencing the main staircase at the level of the street, with the pit below, and the upper circle and galleries above. Since ventilation would necessarily be effected from the top of the building, the placing of one tier below would make no difference. The heat in theatres was made a ground of complaint. Of course it was hot in a theatre, as it was in any crowd whatever. If in the building of a theatre they tried to please everybody, there would be no building at all.

Mons. F. Bouhon, architect (Member of the Commission on Unhealthy Dwellings, Paris), said he was astonished at not having heard any resolutions presented by the readers of the papers. The arrangement shown in diagram No. 4 seemed to him the most typical of what to avoid. All Frenchmen coming to London—the birthplace of sanitation—were astonished to see so many cellars used, more or less, as dwellings. Even in great and handsome buildings they saw persons living in rooms below the ground. Cellar dwellings to a Frenchman were the most intolerable things that could be imagined. After the terrible fire at the Opéra Comique, in Paris, a law had been passed of a stringent character, one of the provisions of which was that there must never be any portion of the auditorium below the ground. Let England, which had so many living-rooms and kitchens below ground, take good heed of that new law.

Dr. Dolan (Halifax) described some miserable dressing-rooms that he had seen in provincial theatres. He had in his mind one at that moment no larger than the reporters' table, in which the girls had to do all their changes and all their dressing. On one evening he was called to one of the girls who had a sprained ankle. He found no conveniences of any kind such as the circumstances required, no hot water and no cold water, except such as could be contained in a small tin can, and no conveniences for washing. The other dressing-rooms were in the same miserable condition. He had traced absolutely typhoid fever, loss of voice, and other diseases, many of them of an infectious kind, to the defective sanitation of theatres. The mills in Halifax were under regulation, and must be sanitary, and it was not too much to expect that proprietors of theatres should be under the same obligations as to sanitary provisions. Until the force of public opinion was brought to bear upon proprietors and managers of places of public amusement, the present miserable state of things would doubtless continue. He most cordially congratulated Mr. Lennox Browne and Mr. Turner on the admirable character of their papers.

Mr. Lennox Browne, on being called upon to reply to the various speakers, said he could not agree with Mr. Emden, who had said that isolation was not necessary. How could you get ventilation if there was no open space at the back? He could not follow the meaning of Mr. Emden when he said that ventilation was only possible from the top. In a theatre at Vienna there was a fan arrangement by which hot or cold air could be admitted from a valve placed under the seat, and either hot or cold air could be turned on at the will of each individual occupant.

Some Insanitary Superstitions in House-building.

BY

H. HEATHCOTE STATHAM, F.R.I.B.A.

The remarks in this paper refer more especially to houses built in large and crowded cities. Houses built in open situations in the country are permeated by an atmosphere comparatively pure and clean. Houses in large towns are permeated by an atmosphere laden with impurities, which are continually being deposited on every surface that will retain or absorb them. They are also subject, unless carefully watched, to the incursion of various types of vermin, from the popular cockroach down to even more noxious and happily rarer examples. It is therefore desirable that they should be constructed of materials least likely to absorb and retain impurities, and that the method of construction should be such as to leave no unlighted and inaccessible spaces.

The habitual construction of ordinary houses in England is not in accordance with these requirements. For many generations the orthodox manner of making a house floor has been to lay wooden joists from wall to wall with boards nailed down above, and a lath and plaster ceiling beneath, the space between being an unseen cavern for the accumulation of whatever dirt and decaying matter can find its way in. What the results may be I once saw in the worst form in a case where the boards of an East End schoolroom were taken up to ascertain the condition of the joists. The space between those joists was filled nearly to the top with a festering mass of dirt and dust, over which the children had been daily collected. Such a floor would not be allowed in a modern London board school, but it is the accepted floor for a dwelling house; and though the conditions of a well-kept dwelling house do not encourage such an accumulation as this, I believe the tenants of the best kept London house which has been inhabited for any length of time would be disagreeably surprised at the amount of dirt they would find under their flooring boards if they looked for it. The old-fashioned system of ceiling up to the under side of the flooring boards and leaving the joists visible is far more sanitary; the drawback is that it is unsightly, and that it does not shut out sound sufficiently. Double flooring boards with felt between would get over the latter objection to some extent; but what I wish to recommend is the general adoption of solid floors of iron and concrete with a wood block or plain

parquet floor on them, for the average town dwelling house. They are almost necessarily adopted for houses in flats, why not for every dwelling house?

In the same way it has for many generations been the recognised faith that a house roof can only be made by means of rafters laid on the slope with a tie at the foot, and with ceiling joists either at the springing of the roof or part way up the slope. The advantage of this is that the upper rooms which go partly into the roof are rendered inconvenient and unsightly by a low sloping ceiling to half the room, and that above the ceiling joists is a dark cavern between them and the roof, into which no one ever sees, and where dirt may accumulate and vermin may breed undisturbed. It is really an almost alarming thought to reflect what is the probable cubic content of these dark caverns in the roofs of houses over all London. If it be thought necessary to go on building sloping roofs, either the whole slope of the roof should be thrown into the top rooms, as the visible ceiling, or the ceiling of the highest living rooms should be at the level of the roof springing, and the space between that and the rafters should be treated as storage space easily accessible and sufficiently lighted to be readily examined from time to time. But in fact it is entirely unnecessary, in these days of iron, and concrete, and tile, that we should build sloping roofs at all; the doing so is a mere superstition, except where reasons of architectural effect are concerned; and certainly architectural effect does not concern itself much in the ordinary house roof. With flat roofs with a cement finish and sufficient fall to run the rain to the gutters, we should get rid at once of all these dark caverns, the exterior and interior of the roof would coincide in shape, and convenience and healthfulness would be alike consulted.

The whole tribe of things called "skirtings" and "casings" are superstitions of the same kind, for providing dark inaccessible places where no cleansing hand can ever come. Baths and watercloset basins are surrounded with those foolish fences of joinery; whited sepulchres, which indeed appear neat outwardly, but within they are full of—no one knows what, for no one ever looks. Let both watercloset and bath stand open to inspection all round, instead of being cased in. In the matter of the bath, the money spent on panelled casing and "polished baywood or mahogany top" would go far to render the bath itself a neat and presentable piece of furniture.

This system of ornamental casing is carried out again in the wooden skirtings which are fixed at the base of the walls of each room. Skirtings may be considered necessary for three reasons—for appearance, for a stop to the plastering, and to prevent chairs and other articles of furniture knocking against and injuring the paper and plaster. But they should be in a solid thickness of wood of no greater projection from the plaster surface than is necessary for their practical object. Unfortunately, it is considered necessary that the larger and more dignified a room is the larger moulding and the greater projection the skirting should have. As we are not going to the expense of putting down moulded timber three inches thick round the room, a moulding of the desired projection is fixed on the top and a piece of inch-and-a-quarter wood fixed between that and the floor, with a nice hollow space

behind. The result is often rendered audible by the scuttering and scrambling of the mice, who are enjoying their gambols in the private corridors which we have obligingly provided for them.

Casings for pipes are, no doubt, necessary, and are generally specified to be screwed on, so as to be removable when required. They never are removed, or the space behind seen, except when something is wrong with a pipe. They should be hinged, and made with button fasteners, so that they can be opened every day without any trouble. Among other drawbacks, they form a private lift or elevator for the cockroach, who is fond of warmth, and is enticed to ascend along the line of the hot-water pipes. The cockroach is bad enough in the kitchen, but a good deal worse in the bedroom it is hardly worth while to afford him the luxury of a private passage, heated with hot water, to the upper floors.

The passion for sash-windows in this country leads to the employment of another system of wooden cradling built up round the windows, with hollow inaccessible boxes for the lines and weights, besides (generally speaking) another set of hollow spaces behind the back of the shutter casings. It is perfectly possible to make sash-windows without pulleys and weights in more ways than one, unless when they are very large and heavy. But the casement window has the advantage that it can be hung in solid frames without any of this bandbox work round it, and making it weather-tight is merely a matter of care and scientific construction. It is worth consideration whether we should not do better to return to it as the more wholesome and sensible structure of the two.

Another curious superstition is that windows must have curtains. The recognised principle seems to be to make windows much larger than is necessary to light the room, and then to stop out a great deal of the light by hanging curtains over them. This seems hardly either sensible or sanitary. Curtains are terrible collectors of dust and dirt. Everyone knows that a curtain that has been up three weeks in London is hardly fit to touch; and is there any reason, in the nature of things, why windows must have these draperies? Suppose we tried smaller windows, and a more decorative treatment of the frames and glazing, and left them unencumbered by curtains. We should get as much light in a more healthy and sensible, perhaps even in a more decorative manner. Think of the treatment of windows in oriental houses in Cairo and elsewhere. That could not be copied for this duller climate, nor are copies desirable; but it may afford a hint for a modification of decorative treatment of somewhat similar type.

Wall paper is a simple and inexpensive means of producing decorative effect in a room, but papers should be close in texture and smooth in surface. Papers with embossed surfaces, and, above all, what are called "flock" papers, are dust holders, and such wall surfaces cannot be kept properly clean. Coloured plaster, finished with a hard surface, is more sanitary than any paper, considering that the paper has a layer of paste behind it which becomes rotten in time. If, however, papers are renewed often enough, and the plaster stripped and well scoured at each renewal, the insanitary element in them is not of sufficient importance to counterbalance the decorative gain.

Large and deep plaster mouldings and decorations are now, fortunately, going out of fashion on æsthetic grounds; they are injurious to the cleanly condition of a house, affording so many pockets for the lodgment of dirt. As long as they are kept flat and in low relief there is no harm in them. The wooden mouldings with a hollow on the top, which are now much used to take picture-hooks, are objectionable, as the hollow is always full of dust. The old brass picture-rods are much to be preferred in this respect.

Furniture, which is a kind of minor architecture, has its superstitions of construction, the worst of which is the system of finishing large wardrobes, book-cases, &c. with a cornice standing up all round the top, leaving a wide pit for dust, which is never seen, and cannot be swept. This cornice is a mere fashion, utterly useless and absurd. The top should be made level or (still better) sloping, and with no raised ledge above it, so that it can be swept. It is best of all to make large erections of this kind as fixtures carried up to the ceiling, and finished with a moulding against the ceiling; then there is no place where dust can accumulate.

The last superstition I will mention concerns that important receptacle—the cistern. It might be supposed that the reservoir where we store our water for drinking, washing, and cooking, would be an object of some interest to the householder; that he would desire always to see and know that it is pure and clean. But it is a superstition that the cistern must not be seen; it is kept in the dark, and generally in a place which is very difficult to get at. When it is supposed that it must want cleaning, it is a business of engaging a man specially who, perhaps, has to bring a ladder to get to it. I knew a case where the water in the house began to have an evil taste, and it was found that a dead bird had been in the cistern for many days in an advanced state of putrefaction. The cistern should be in a well-lighted place, where it can be easily seen every day. The best way would be to make it as an aquarium tank is made, with a front of plate glass, so that you can see the light through the water.

To keep a town house thoroughly clean is a continual fight, not only against accumulation of dirt, but against vermin. I remember one case where a nobleman who had become tenant of a house in one of the best terraces in London, at a very large rental, brought an action for compensation against the landlord because the house was found to be full of unmentionable insects from top to bottom. This was an exceptional case, and argued great neglect on the part of someone; but it is a fact that the chances are far greater for this sort of pest in houses built with hollow floors and a great deal of woodwork than they would be with solid floors and skirtings without recesses behind them. Generally speaking, the clean and healthful condition of town houses is greatly assisted by the use of non-porous materials as far as possible, and the avoidance of all dark and inaccessible corners. The present system of building town houses is exceedingly faulty in these respects, is capable of radical improvement, and should be improved accordingly

DISCUSSION.

Mr. H. H. Collins said, with regard to solid floors, there were other materials besides iron and concrete that might be used. Among those that might be mentioned were terra-cotta and coke-breeze. One point alluded to was worthy of special consideration. In Captain Shaw's book it had been shown that wood was not the inflammable material it was generally supposed to be. It had been found that beams 12 inches square, after the fiercest fire, stood the ordeal so well, that, if peeled, they could be used again. A floor had been patented which was composed of solid wood blocks. Such floors were not very expensive, and could be produced for 6*s*. per yard. With regard to roofs, there were climatic reasons for preferring sloping to flat roofs. In winter flat roofs would retain a great weight of snow. The casement windows recommended by Mr. Statham would be very inconvenient, particularly in small rooms with much furniture in them. He agreed with the paper with regard to skirtings, and he objected to picture rods; there was a system of picture-mouldings, which he preferred.

Colonel Prendergast said he should have liked to hear further discussion with regard to solid floors; but met, as that section was, to deal with sanitary matters, they would, perhaps, do better to try to find out how far block floorings would tell against the efficient ventilation of rooms. If there was a ventilating flue, that flue must produce a current of air, and the instant one did that in went the bundle of rags to stop the ventilation. On the question of roofs Mr. Statham had done good service. In Italy, and in the buildings of ancient Greece, flat roofs were universal. But in this country we were told we had no climate, and, therefore, flat roofs were impracticable. If Mr. Statham could solve that problem, he would do a very great service to the community. In concluding, Colonel Prendergast said he could see no reason why they should not have solid floors made of paper.

Mr. Ralph Nevill, F.R.I.B.A., said they had in Mr. Statham's paper a condemnation of boarded floors, and if the author could get all architects to follow his example he would do them a good service. It was, however, a question of cost. Six shillings a yard did not seem much for a solid floor, but in the great majority of buildings the expense would be the great obstacle to their adoption. In the ordinary boarded floor the sole object of cleaning up seemed only to be to wash dirt into the cracks of the floor with dirty soap and water. Solid block floors would be difficult to level if laid on breeze, and such floors would, he conceived, require a layer of asphalte to prevent rot. He recommended the French system of bees-waxed floors. It was a great pity we had none in England. Ladies objected to dance on solid floors, and there was the sound difficulty. The experiments made many years ago in this line of investigation by Mr. Thaddeus Hyatt were worthy of attention. The speaker differed from Mr. Statham as to flat roofs, which would be a constant source of trouble; and such an enormous amount of guttering was required with such roofs that they would be continually in want of repairs.

Mr. J. P. Seddon, F.R.I.B.A., agreed on most points with the paper. Solid floors need be no disadvantage to ventilation. Pipes to convey air should be laid, passing from the floor through to the fireplace, just as water pipes were laid. He was in accord with Mr. Statham in his jeremiad against hollows. Hollow walls were intolerable for

harbouring vermin. A very perfect and cheap wall could be made with two 4½ inch brick walls, with an inch air space. The inside joints might be left a little open, and the cavity filled in with Portland cement grouting, and the courses might be bonded by a few tie-courses being placed under or over the window. The walls thus became very solid.

Col. Seddon, R.E., referring to the passage in favour of solid floors, described arrangements adopted by him for forming of concrete the floor of a gun battery at Portsmouth. After a time it developed cracks. These he filled up with old railway iron, which, when laid in the cracks, stopped all further vibration. He had built barracks on the same kind of site, which was very irregular, having here and there pockets of soft ground, and in other places spots of hard ground. Again, he laid in the crevices pieces of railway iron, but to form the floor he employed large man-of-wars cables cut into the required lengths, crossing and re-crossing one another in all directions, and embedded in the concrete. There had been attempts to produce the same results without the use of cables, but they had always failed.

Councillor Hannam (Leeds) agreed with the suggestions for solid floors; wood blocks might be laid down for 6*s.* per yard of flooring, but this sum would be for the wood merely. The expense would always be a great difficulty in the way of the general adoption of solid floors. Concrete roofs also were very costly, and flat-roofed buildings always had an unfinished look. In the absence of high-pitched roofs, it would be necessary to carry their chimney stacks to a much greater height. They would often require to be 14 feet or 15 feet high above the square of the building, and in most cases such a height would, with only our present resources, be practically impossible.

Sir Arthur Blomfield said he once had experience of the advantage of using iron bars in the same way as had been described by Colonel Seddon. When he (the Chairman) was a much younger man, he had the task of erecting a church on a very treacherous foundation between a railway and a river. It had given him a great deal of anxiety. He had tried various devices with but little success, until he struck upon the plan of laying down iron bars near the bottom of the concrete. Since then he had observed no symptoms of further settlement.

Dr. Wilberforce Smith said the advantages in crowded districts of utilizing the roof seem indisputable if there be no associated drawback of an important kind. Those advantages are mainly—1. Economy of space.—The utilization of immense areas which at present are as unemployed as if they formed part of a remote prairie, and this in districts, *e.g.*, in London, where every square yard of land is of fabulous value. The gain represents an additional stage added to each building without increased height. 2. Economy in regard to sky space.—So far from involving any encroachment on the sky-view, the plan advocated effects in most cases a gain of sky-space if it take the place of a span-roof, and it is obvious that the human beings forming the only additional mass above the roof are insufficient by their bulk to create any appreciable set-off. 3. Purity of atmosphere.—Few persons appear to have any conception of the gain of freshness in the atmosphere at the level of the roof as compared with the street below. Such was his experience when he first read a paper on the subject at the British Medical Association in 1876, and experiments made from time to time ever since have only confirmed this experience. On the extensive roof of the Higher Grade

School in Leeds, the children enjoy an atmosphere fairly comparable with that of the moor outside the town. There is a singular misconception as to the prevalence of soot about the roof. Even for the dwellings of the wealthy there would, in some cases, be great advantage in the utilization of the roof. In his experience, the residents of South Kensington, for example, notwithstanding sanitary advantages, mostly feel every summer the relaxing effect which belongs to the lower level of their district; in such situations the fresher atmosphere of upper floors is well known, and must be experienced at its best upon the very roof. 4. Minor advantages over recreation places on the level of the street are such expansion of view as a town can aford, and the increased quiet. For the tired brain of a worker in town, it is difficult to find any wholesome refreshment so prompt as a retreat to the comparative quiet and freshness of the roof. 5. Details of construction appear to involve no practical difficulty—such is the result of somewhat extensive inquiry—but here he especially desired the opinion of architects attending the Congress. The various uses to which the roof-space has been already applied include those of playgrounds for school children, and drying-grounds for clothes. The space is equally available for cultivating plants, and as a fresh air resting place for adults.

Mr. Statham, in answer to the various speakers, said with regard to concrete floors, he had only mentioned that one method of forming solid floors, because it was the least costly, and that consideration must be kept in view. He did not positively recommend flat roofs; he only suggested them.

Four-inch Drains versus Six-inch Drains.

BY

G. M. Lawford, Assoc. M. Inst. C.E.

It is a matter of every-day occurrence to find a 6-inch pipe used for the drainage of a single house, and this size is usually made compulsory by sanitary authorities, whether metropolitan, urban, or rural.

As a house drain is frequently dry for several hours at a time, it is obvious that where pipes of this diameter are used there must be a considerable extent of surface on which sediment is deposited, and as a natural consequence, during the periods of minimum flow this deposit will decompose and foul gases will be generated. If the house-drain is properly disconnected from the main sewer, and efficiently ventilated, a large proportion of these gases will undoubtedly be carried off and liberated in the atmosphere, but the tendency of the remainder will be to move in the direction of the house by reason of the absorptive influence of the warmer air within.

The author contends that this generation of gases in the house-drain, apart from its being adverse to the principles of sanitation, is preventible, the remedy lying in the use of smaller pipes.

Taking as an example the case of an ordinary sized town house, with an average of 10 inhabitants, and allowing 30 gallons of waste water or liquid matter to be discharged per head per day, the total volume would be 300 gallons per day, and of this amount at least one-half must be reckoned as being discharged in six hours, thus giving 25 gallons per hour as the maximum flow to be provided for. To this amount must be added the rain-fall from the roof and areas which, as a rule in the case of town houses, is taken into the sewer. The superficial area to be dealt with under this heading varies from 1,000 to 10,000 square feet; taking 6,000 square feet, which is considerably in excess of the average, and allowing for 1¼ inches of rain-fall per hour (thus providing for the heaviest thunderstorms), the total volume of rain-fall to be dealt with would be 3,900 gallons per hour. The maximum hourly discharge of sewage and rain-fall combined would therefore be 3,925 gallons, or 65·4 gallons per minute, and a 4-inch pipe will discharge this amount when running full at the very flat gradient of 1 in 207·36, the velocity produced being 2·02 feet per second, which is barely sufficient to make a drain self cleansing.

As the conditions on which these figures are based are only likely to occur once or twice a year, if at all (*i.e.*, during an exceptionally severe thunderstorm), it is evident that without special arrangements for flushing, even a 4-inch drain can scarcely be made absolutely self cleansing, more particularly as the usual gradient is from 1 in 40 to 1 in 60 with a consequent increase of discharging capacity.

The author therefore considers that under ordinary circumstances a 4-inch drain is ample for an average sized house, and that a 6-inch drain is too large to be kept free from deposit, more particularly as the majority of the pipes discharging into it are three inches or less in diameter. Baths, lavatories, and sinks never have waste pipes exceeding two inches internal diameter, and it is the exception to find more than one appliance being discharged at a time. The question therefore naturally arises "How can a 2-inch pipe possibly flush and cleanse a "pipe nine times its own sectional area?"

The soil pipe is the only pipe of larger size which ever discharges at full bore, and the amount discharged at one time (two or three gallons at the most) is insufficient to make a 4-inch horizontal drain run even half full for more than a few feet.

Automatic flushing is of the greatest assistance in keeping a drain free from deposit, and should be adopted in all cases where possible, and more particularly in cases where, from the depth of the main sewer, the inclination of the house-drain exceeds 1 in 60.

A tank containing not less than 30 gallons is sufficient to cleanse a 4-inch drain by means of a 2-inch syphon and flushing pipe, and it should be placed at the extreme end or head of the drain at least six feet above the latter point.

The author maintains that by using a 4-inch drain laid at a uniform inclination not exceeding 1 in 60, aided by automatic flushing, all refuse and other matters discharged into it will be removed in the shortest time and with the minimum of deposit, and to those who say that a 4-inch drain would be choked by such extraneous objects as a duster, a medicine bottle, or a hair-brush, the saying, "a place for everything and "everything in its place" may be aptly quoted, as a house-drain cannot obviously be the proper place for a hair-brush, and the removal of such articles can be effectually provided for by making every length of drain accessible from inspection chambers.

Another argument in favour of the 4-inch pipe is the increased circulation of air in the drain, as by diminishing the sectional area of the passage, the velocity of the air current is considerably accelerated; the volume of air which has to be set in motion in order to produce circulation in a 6-inch pipe being more than double (2·24 times) the volume in a 4-inch pipe.

Gases generated in a 4-inch drain would certainly be carried away more quickly than in a 6-inch drain, apart from the fact previously stated that the possibility of the creation of such gases in a 4-inch drain is reduced to a minimum, while in a 6-inch drain their existence is an absolute certainty.

To summarise briefly, the objection to a 6-inch drain is the fact that deposits must be formed from which noxious gases are generated, with the probability of contaminating the air in the house, while the advantages of a 4-inch drain are:—

(1.) Deposit is reduced to a minimum;

(2.) Its size is ample for the discharge of the greatest amount of waste and rain water that can possibly pass into it;

(3.) When combined with automatic flushing at regular intervals, absolute cleansing is obtained; and

(4.) The increased strength of the air currents and the consequential more effectual and rapid purification of the drain.

The author would, therefore, in conclusion, urge on all sanitary authorities the advisability of reducing the sizes of house-drains as laid down in the existing byelaws and regulations, for while they all endeavour to exclude sewer gas from house-drains by means of disconnexion and ventilation, the question of its generation in the drains themselves has apparently been hitherto overlooked.

Thursday, 13th August 1891.

The President, Sir ARTHUR BLOMFIELD, in the Chair.

Étude sur les principales causes d'insalubrité des Habitations Ouvrières Parisiennes.

PAR

ÉMILE CACHEUX, Ingénieur, chargé de l'installation de la Section XI. (Habitations Ouvrières) à l'Exposition d'Économie Sociale en 1889.

Depuis longtemps on a remarqué que dans les grandes villes la mortalité varie de 16 à 50 pour cent suivant les quartiers, c'est pourquoi on y a fait de grands efforts pour détruire cette inégalité. Dès 1842, *the Society for Improving the Dwellings of the Labouring Classes* fut fondée à Londres pour tâcher de réduire la mortalité excessive que l'on observait dans les logements d'ouvriers. Grâce à ses travaux et à ceux de l'association métropolitaine, il fut bientôt démontré qu'en améliorant les petits logements on pouvait diminuer considérablement le taux de la mortalité dans les maisons modèles, et comme les résultats obtenus firent voir que les logements pouvaient être loués de façon à rémunérer convenablement le capital engagé, la spéculation s'occupa de la construction d'habitations ouvrières et elle parvint à loger les habitants de Londres, de telle sorte qu'aujourd'hui la mortalité ne dépasse pas le chiffre de 19 pour cent.

A Paris le taux moyen de la mortalité est de 24 pour cent., mais dans les quartiers excentriques il atteint 36 pour cent. Par suite, si l'on pouvait détruire les causes de mortalité qui existent dans ces quartiers de façon à y rendre le nombre des décès égal à celui qu'on observe dans les villes anglaises, on rendrait un immense service à la population parisienne.

Nous avons fait une enquête sur l'état hygiénique de plusieurs de ces quartiers et nous n'avons pas eu de peine à nous convaincre que l'influence du logement était pour beaucoup dans la mortalité élevée qui existait dans les quartiers ouvriers, c'est pourquoi, dès 1875, nous avons commencé, M. Émile Muller et moi, une campagne pour améliorer les habitations de nos travailleurs. Le succès obtenu en Alsace, par mon vénéré maître, qui construisit les Cités-Ouvrières de Mulhouse, nous engagea à persévérer dans cette voie malgré les nombreux mécomptes que nous éprouvâmes. De nombreuses personnes se joignirent à nous pour entreprendre la réforme des petits logements, parmi elles nous citerons M. Émile Trélat, qui signala au Congrès d'Hygiène de Vienne le grand inconvénient qui résulte pour les Parisiens de l'utilisation trop complète du terrain à bâtir, et il démontra que même dans les maisons les plus luxueuses la santé était compromise par le manque de lumière.

Le remède préconisé par M. Trélat est l'expropriation des maisons trop hautes et la démolition des étages trop élevés de façon à pouvoir soumettre tous les locaux d'une maison à l'action des rayons solaires. J'ai cherché à résoudre le problème du désencombrement des quartiers du centre en essayant d'attirer les ouvriers dans les arrondissements excentriques de Paris et dans les communes voisines, en mettant à leur disposition des maisons susceptibles d'être acquises par annuités.

Mon exemple a été suivi, aujourd'hui il ne reste plus de champs dans l'enceinte de Paris, et on n'y voit plus fonctionner la charrue comme du temps où j'ai commencé mes travaux. Malheureusement l'ouvrier ne se rend pas compte du dommage qu'il cause à sa santé et par suite à son avoir, en ne consacrant pas à son loyer une somme suffisante pour être logé convenablement, c'est pourquoi la spéculation ne lui fournit pas un logement à aussi bon compte que les autres choses nécessaires à la vie. Pendant longtemps les hygiénistes et les philanthropes furent obligés de lutter pour decider nos compatriotes à imiter les Anglais, mais aujourd'hui nous pouvons dire que le succès a couronné leurs efforts. En effet, l'état des habitations ouvrières parisiennes tend de plus en plus à s'améliorer, grâce aux nombreux efforts qui sont faits à cet effet. Nous sommes loin de prétendre que tous les travailleurs parisiens sont logés conformément aux lois de la morale et aux règles de l'hygiène, car pour atteindre ce but il faudrait remédier à diverses causes qui ne disparaîtront que par suite des efforts combinés de l'État, des municipalités et des particuliers. Nous avons longuement parlé, dans l'ouvrage intitulé les Habitations Ouvrières en tous pays, de ce qui pourrait être fait dans ce sens par les pouvoirs constitués et par l'initiative privée, c'est pourquoi nous ne dirons ici que quelques mots sur ce qui devrait être tenté pour propager les petits logements convenables. Tout d'abord nous croyons que l'État rendrait de grands services à la cause que nous défendons, s'il modifiait les lois relatives à la transmission de la propriété et à la gestion des petits logements. Ainsi, un des plus grands obstacles qui s'opposent à la vente par annuités de petites maisons, provient du prix élevé des droits de mutation qu'il faut payer lors de la signature du contrat de vente ; d'après nous, l'État faciliterait beaucoup l'acquisition de maisons par petits versements, s'il exigeait le montant des droits de mutation au moment de la signature de la quittance notariée libérant définitivement l'acquéreur à l'égard de son vendeur.

En ce qui concerne la gestion des petits logements les modifications législatives seraient assez nombreuses. Nous verrions, sans déplaisir, promulguer en France une loi analogue à celle qui l'a été en Belgique, et qui aurait pour objet de supprimer le privilège du propriétaire sur les meubles du petit locataire, mais qui, par contre, lui permettrait de l'expulser lorsqu'il ne tiendrait pas ses engagements et ce à l'aide d'une procédure qui ne reviendrait qu'à une quinzaine de francs. En tenant compte de cette proposition, le législateur couperait court aux abus signalés dans divers quartiers de Paris, qui consistent à forcer les propriétaires à dépenser 70 francs pour expulser des individus qui demandent de l'argent pour quitter des logements dont ils ne paient pas le loyer.

L'administration devrait également répartir les impôts de façon à ce que les petits propriétaires ne soient pas forcés de payer des contributions qui représentent jusqu'à 12 pour cent du revenu brut de leurs propriétés.

Ainsi que je l'ai plusieurs fois démontré, ce sont les charges excessives qui grèvent les petits loyers qui empêchent les capitalistes de faire des placements immobiliers, c'est pourquoi j'ai cherché à les faire diminuer le plus possible. D'après moi, les municipalités pourraient obtenir de beaux résultats en réduisant les charges qui incombent à la petite propriété ; ainsi à Paris une rue classée revient au minimum à 400 francs le mètre linéaire, tandis qu'il serait facile d'établir des rues coûtant dix fois moins pour desservir des cottages. En ce qui concerne la fourniture de l'eau potable, l'évacuation des eaux ménagères, l'enlèvement des vidanges, les frais qui y sont relatifs sont peu importants quand il s'agit de maisons à étages, mais il n'en est plus de même quand ils concernent des maisons pour une famille. Dans ce cas les charges d'une maison louée à 300 francs peuvent s'élever à plus de 40 pour cent du loyer, sans tenir compte des réparations. Ainsi le prix d'une concession d'eau de 125 litres par jour est à Paris de 128 francs par an, celui du droit d'écoulement des vidanges à l'égout de 30 francs, le nettoyage de l'égout particulier coûte de 10 à 11 francs. La valeur de ces taxes étant établie par maison, proportionnellement à leur nombre, on comprend qu'elle soit excessive pour l'habitant d'une petite maison. Dans les environs de Paris, les charges dont nous parlons sont encore plus élevées. A Vanves, par exemple, la Compagnie des eaux ne délivre pas de concession d'eau à moins de 70 francs par an, c'est pourquoi j'ai établi des citernes pour desservir plusieurs maisons. Le prix des citernes étant de 300 francs, la fourniture de l'eau revient par maison à 15 ou 20 francs.

A Saint-Denis, où l'on arrive à établir des maisons pour 2,000 francs, la Compagnie des eaux demande pour délivrer une concession 65 francs par an.

La Ville de Paris a édicté des réglements sévères concernant les logements. Nous croyons qu'elle les ferait mieux observer si elle s'adressait aux locataires au lieu de s'en prendre aux propriétaires. Ainsi quand un locataire est atteint d'une maladie infectieuse, on force le propriétaire à désinfecter le logement contaminé, par suite il perd non seulement son loyer, mais il est encore obligé de dépenser une somme double pour remettre les lieux en état d'être reloués. Si les locataires étaient rendus responsables des frais qu'ils occasionnent aux propriétaires, ils iraient se faire traiter dans des hôpitaux spéciaux dès qu'ils se ressentiraient des premières atteintes d'un mal contagieux.

La Ville de Paris accorde des secours aux malheureux qui ne peuvent payer leurs loyers. Ces secours ne sont distribués qu'aux locataires expulsés judiciairement. Il résulte de ce fait que ces derniers ne quittent plus un logement à l'amiable et qu'ils forcent le propriétaire à depenser en frais de justice le double de ce qu'accorde la municipalité.

En résumé la Ville de Paris devrait favoriser la construction de maisons pour une famille et non celle de bâtiments à étages dont un des plus graves inconvénients est d'abrégér la durée de la vie humaine.

Malgré les sommes immenses dépensées pour embellir Paris, la mortalité dans cette ville ne diminue pas sensiblement, elle est encore de 24 pour cent, tandis que dans plusieurs villes du Nord elle a été abaissée à 18 pour cent.

Action de l'Assistance Publique.—L'administration de l'assistance publique se borne à Paris, à payer les loyers de quelques familles malheureuses. Nous ne croyons pas qu'elle aurait intérêt à construire des maisons, soit pour les vendre, soit pour les louer, comme le font plusieurs administrations charitables en Belgique, mais nous estimons qu'elle rendrait service en prenant des obligations hypothécaires rapportant 4 pour cent, émises par des sociétés philanthropiques qui construisent des habitations ouvrières, telles que la Société de Passy-Auteuil par exemple.

Action des Caisses d'Épargne.—La Caisse d'Épargne de Paris n'a pas jusqu'à présent voulu suivre l'exemple donné par les Caisses d'Épargne de Lyon et de Marseille, qui ont consacré une partie de leurs réserves à provoquer la construction de petits logements convenables.

Sociétés Savantes.—Les Sociétés savantes parisiennes ne se sont pas encore occupées de chercher à résoudre les divers problèmes relatifs au chauffage, à la ventilation, à l'évacuation des vidanges des habitations ouvrières. La Société de médecine publique a beaucoup travaillé pour assainir les logements, mais elle n'a pas tenu assez compte dans ses vœux adressés aux pouvoirs publics des charges qui résultaient de ses prescriptions, c'est pourquoi elle a rencontré une certaine hostilité de la part d'un grand nombre de propriétaires de petits logements.

Action des Compagnies de Chemin de Fer.—Les Compagnies de chemin de fer ont contribué de deux façons à l'encombrement des habitations ouvrières parisiennes, savoir :—

1° en prolongeant leurs voies dans l'intérieur de la ville, ce qui amena la démolition d'un grand nombre de logements ;

2° en provoquant dans Paris l'arrivée de beaucoup de petits employés.

Les Compagnies ont tâché de remédier à cet état de choses :—

1° en créant des trains spéciaux qui transportent à bon compte les ouvriers qui habitent en dehors de Paris ;

2° en provoquant la construction de petits logements.

Un des procédés les plus efficaces consiste à prêter, comme l'ont fait les Compagnies d'Orléans et de Paris, Lyon, de l'argent au taux de 3 pour cent l'an, à des sociétés philanthropiques qui s'engagent à loger un certain nombre de leurs ouvriers.

Action des Industriels.—Les Industriels parisiens font peu de sacrifices pour loger convenablement leurs ouvriers, car la main-d'œuvre n'est pas rare à Paris, et l'organisation du travail est telle que la majeure partie des objets manufacturés sont faits avec des machines, ce qui permet d'employer des hommes n'ayant pas fait d'apprentissage spécial.

Action de la Spéculation.—La spéculation s'est occupée dans ces derniers temps de faire des petits logements convenables ; malheureuse-

ment par suite du prix élevé de revient des habitations, les logements mis à la disposition des travailleurs se composent en général de deux pièces et d'une cuisine et se louent de 300 à 500 francs suivant les quartiers. Il est donc nécessaire que la philanthropie s'occupe de la question des habitations ouvrières, jusqu'à ce que la spéculation trouve intérêt à établir des petits logements.

Dans quelques cas spéciaux des industriels ont résolu le problème de loger le travailleur, convenablement et à bon marché. Ainsi M. Fouquiau vient de commencer le lotissement de 180,000 mètres de terrain, dans le XVIIIe arrondissement. Il construit des maisons qui comprennent quatre pièces et il les vend moyennant une annuité dont la valeur est inférieure à celle du loyer d'un logement de surface équivalente. Son type le meilleur marché est vendu clefs en mains au prix de 6,000 francs ou moyennant le paiement comptant d'une somme de 500 francs et celui d'une annuité pendant 50 ans. La valeur de cette annuité est de 390 francs pendant les quinze premières années qui suivent la signature du contrat et de 190 francs pendant les trente-cinq autres. L'acquéreur peut se libérer par anticipation.

M. Verberckmoës a construit des maisons à étages à Clichy en opérant de la même façon que la célèbre société, *the Improved Dwellings Company*, de Londres. Il a acheté un terrain, d'une superficie d'une centaine de mille mètres, couvert de constructions dans un état déplorable qu'il commença par démolir, puis il lotit son terrain en le perçant de rues, il en donna une partie à la commune pour faire un groupe scolaire et il provoqua la construction d'une église en cédant à bas prix l'espace nécessaire. Pour amener du monde sur son terrain, M. Verberckmoës construisit cinq maisons à quatre étages qu'il divisa en petits logements et qu'il loua de façon à retirer un revenu de 4 pour cent net de son capital engagé. Les maisons étant constamment occupées, M. Verberckmoës chercha à augmenter l'importance de ses opérations en s'adressant au Crédit Foncier, mais cet établissement ne put lui être d'aucun secours, car d'une part il prête de l'argent au taux de 4·5 pour cent et d'autre part il n'avance sur hypothèque que le tiers du prix de revient d'une maison destinée à loger les ouvriers. Plusieurs autres établissements de crédit immobilier ayant refusé de consentir à prêter de l'argent à des conditions plus avantageuses que le Crédit Foncier, M. Verberckmoës s'adressa au public pour trouver l'argent nécessaire à l'utilisation de ses terrains. A cet effet il proposa d'apporter à une société constituée au capital d'un million, dix mille mètres de terrain en échange d'actions libérées, dont la valeur eut été égale à celle du prix de revient du terrain apporté. Malgré la situation morale et financière du promoteur de l'entreprise et l'appui moral qui lui fut donné, le public resta indifférent à ses démarches.

Une autre tentative faite par les industriels de Saint-Denis eut un peu plus de succès, mais elle repose plus sur la philanthropie que sur la spéculation, c'est pourquoi nous en reparlerons un peu plus loin.

Action de la Philanthropie.—La philanthropie a servi de base à des opérations immobilières relatives aux petits logements, soit à des sociétés, soit à des particuliers.

La plus ancienne société créée à Paris dans ce but a été la Société des Habitations Ouvrières de Passy-Auteuil. Grâce aux hommes dévoués qui la dirigent—parmi lesquels nous citerons M. le Sénateur Dietz-Monin, M. le Député Siegfried, et M. Cheysson—elle a obtenu de beaux résultats qui éviteront bien des démarches à des sociétés analogues. Ainsi la Société de Passy est arrivée à ne payer que 30 francs par tuyau de chute horizontal, qui dessert une quinzaine de privés, tandis qu'un particulier serait obligé de verser à la caisse municipale une somme quinze fois supérieure, soit 450 francs. Espérons que ce précédent déterminera l'administration des égouts à modifier la taxe relative à l'écoulement des vidanges à l'égout.

La Société de Passy-Auteuil a émis des actions hypothécaires qui rapportent 4 pour cent l'an ; comme ces obligations sont garanties par des propriétés qui ont une valeur double de celle des titres émis, elle a mis à la disposition des travailleurs des placements plus avantageux que ceux de la Caisse d'Épargne.

L'association philanthropique, grâce au zèle de M. Georges Picat, qui a entrepris une véritable croisade pour propager les habitations ouvrières convenables, affecta, il y a trois ans, le produit d'une donation de 600,000 francs faite par M. Heine, à la construction de maisons à petits logements. La première de ces maisons située rue Jeanne d'Arc est divisée en logements de deux pièces, la deuxième établie boulevard de Grenelle contient des logements de trois pièces. La société reconnut que les logements de trois pièces revenaient à un prix trop élevé et qu'il fallait habituer progressivement la population parisienne aux avantages d'une habitation spacieuse, c'est pourquoi elle divisa un troisième bâtiment qu'elle construisit avenue de Saint-Mandé, en logements contenant au plus deux pièces et un cabinet assez vaste pour pouvoir y coucher un enfant.

Les maisons de l'association philanthropique sont louées de façon à faire rapporter 5·6 pour cent brut au capital engagé, 1·6 pour cent, soit 28 pour cent du revenu brut, sont affectés aux charges. Cette proportion est un peu trop faible pour tenir compte des charges d'une maison occupée par des ouvriers, car la pratique a démontré que jusqu'ici le revenu net obtenu a été de 3·80 pour cent. La société pourra donc, dans un temps fort peu éloigné, suivre l'exemple donné par la fondation Peabody en Angleterre, et construire de nouveaux immeubles.

On reproche aux maisons de l'association philanthropique de contenir des pièces qui n'ont qu'une seule fenêtre exposée à l'air extérieur et des privés qui ont un accès direct dans des chambres où il est possible de placer des lits. Nous regrettons que l'habile architecte des maisons de l'association philanthropique ne se soit pas mis à l'abri des critiques que des étrangers pourraient faire à sa distribution en se basant sur la législation sanitaire qui est plus stricte dans leur pays que dans le nôtre. Ainsi, en Angleterre, il est interdit de construire des maisons dites *back-to-back*, c'est-à-dire des habitations qui ont une seule façade exposée à l'air extérieur ; et en Allemagne on ne tolère pas que des privés donnent directement dans une chambre

destinée à l'habitation. Il faut dire que les privés des maisons de l'association philanthropique sont établis suivant le système du tout à l'égout et qu'ils sont soumis après chaque opération à un lavage énergique produit à l'aide d'un appareil fournissant dix litres d'eau à cet effet.

Jusqu'à présent, la pratique n'a révélé aucun inconvénient sérieux relatif à la distribution adoptée par M. Chabral, et grâce aux avantages qu'il a su mettre à la disposition des habitants des maisons dont nous parlons, chaque fois qu'un locataire donne congé dix autres se présentent pour le remplacer.

Nous ajouterons que d'une part la solidité des constructions et d'autre part leur revenu certain ont décidé la Compagnie des chemins de fer d'Orléans à prêter sur hypothèque, au taux de 3 pour cent l'an, tout l'argent nécessaire à une société fondée au capital de 30,000 francs, pour faire établir par M. Chabral des maisons analogues à celles qu'il a fait exécuter pour le compte de la société philanthropique.

Une société d'un genre particulier, la Société française des habitations à bon marché, présidée par M. Siegfried, a déjà rendu, quoique de fondation récente, de grands services en cherchant à provoquer la formation de sociétés de construction d'habitations à bon marché. Grâce à des conférences faites par MM. Siegfried, G. Picat, Rochard, plusieurs sociétés analogues à celles qui fonctionnent avec tant de succès à Mulhouse, à Rouen, au Havre, à Lyon, ont été créées à Belfort, au Havre, à Oullins et à Saint-Denis. La fondation de cette dernière société est due à un concours organisé par la Société française des habitations à bon marché. Ce concours avait pour bu de lotir un terrain d'une surface de 10,000 mètres et de le couvrir de petits logements, 48 concurrents répondirent à l'appel de la société. Les projets exposés à l'Hôtel de Ville furent examinés par M. le Président de la République et par un grand nombre de notabilités.

Des prix d'une valeur de 3,000 francs furent distribués à la suite du concours, mais aucun des concurrents n'ayant rempli les vues du comité d'organisation de la Société des habitations économiques de Saint-Denis, je fus chargé par lui de m'occuper de la question. J'ai commencé par faire une enquête sur les petits logements de Saint-Denis, et je reconnus que si d'une part ils étaient dans un état déplorable, d'autre part il y en avait près des 1,200 qui étaient vacants. Je pus d'autre part m'assurer que la mortalité dans les quartiers ouvriers variait entre 30 et 40 pour cent, c'est pourquoi je conclus de mes recherches qu'il était plutôt nécessaire de construire des maisons modèles que d'établir un grand nombre de logements. Le comité d'organisation adopta mes vues et il se contenta de constituer la société au capital de 300,000 francs, divisé en actions de 500 francs dont le revenu a été limité au taux maximum de 4 pour cent.

Une création originale est due à la Société coopérative du XVIIIe arrondissement. Cette société rencontrant des difficultés pour se loger convenablement acheta un terrain et construisit une maison à l'aide d'un prêt. Grâce aux bénéfices réalisés sur ses opérations la société sera bientôt libérée. Les étages de la maison de la société sont divisés

en petits logements qui présentent une disposition remarquable. Le fourneau de cuisine est adossé à la paroi de la salle à manger, percée de façon que de cette pièce on puisse voir le feu de foyer qui sert à cuire les aliments. L'ouverture est encadrée du côté de la salle à manger par un chambranle de cheminée. En été on ferme l'ouverture à l'aide d'un registre de fonte.

Un grand nombre de particuliers ont contribué à l'amélioration des petits logements parisiens, soit par leurs écrits, soit par leurs travaux pratiques. Citons parmi les écrivains les plus remarquables, MM. Jules Simon, G. Picat, Émile Muller, A. Raffalovich, Anetole Langlois, Cheysson, Antony Roulliet.

Pour mon compte j'ai essayé de propager le plus possible les principes qui doivent guider un bon constructeur en publiant avec M. Émile Muller l'ouvrage intitulé les Habitations Ouvrières en tous pays,* dont à l'occasion de l'Exposition Universelle de 1889 nous avons publié une deuxième édition. J'ai publié seul l'Économiste Pratique et l'État des Habitations Ouvrières à la fin du XIXe siècle, pour rendre compte des travaux pratiques que j'ai faits dans le but de démontrer la possibilité d'introduire, en France, les *Building Societies* qui ont rendu tout de services en Angleterre et en Amérique. A cet effet j'ai construit une centaine de maisons suivant une vingtaine de types différents moyennant des prix qui ont varié de 3,400 à 10,000 francs.

J'ai donné les plans d'exécution de mes types dans mes ouvrages, et je suis persuadé que si une société faisait en grand ce que j'ai réalisé en petit, elle obtiendrait des avantages bien plus sérieux que moi et qu'elle arriverait facilement à rendre beaucoup de locataires propriétaires, soit d'une maison, soit d'une somme d'argent, par le seul fait de payer régulièrement leur loyer pendant un certain temps.

The Insanitary Conditions of Workrooms, Bakehouses, etc., in Paris.

BY

MONSIEUR F. BOUHON, Architect, Paris.

This paper recounts what has been done in Paris by a sub-committee, charged by the Commission on Insanitary Dwellings to prepare a Bill, to be presented to the Chambers, to deal with the work-rooms and kitchens of pastrycooks. With M. André Gély, of the Paris Municipal Council, the writer and three other experts gathered a large body of evidence bearing upon the complaints of the insanitary condition of many of these establishments, presented by Messrs. Hudelo and

* État des Habitations Ouvrières en tous pays, par Muller et Cacheux. État des Habitations Ouvrières à la fin du XIXe siècle. L'Économiste Pratique, par É. Cacheux, Baudry et Cie, 15 rue des Saints-Pères, Paris.

Napias. The causes of unhealthiness found were so much alike in the different cases, and so general, as to justify the sub-committee in regarding them as vices inherent, so to speak, to the business. They were chiefly want of light and air; dangerous position of the ovens and furnaces; open gutters passing through the workshops; want of water, and consequent uncleanliness generally; proximity to the workshops of water-closets and urinals, and the presence, even in the rooms themselves, of portable apparatus for the same purpose, such as open barrels; and, above all, the miserable and dangerous sleeping arrangements for apprentices and workmen. Many employés were compelled to sleep either in the workrooms themselves or in places better described as holes or cellars than as chambers. The fatalities recently occurring in the Rue Gay-Lussac, and in other parts of Paris (they were euphemistically called accidents), were only too easily accounted for by the facts observed by the committee. The furnaces, generally fed by charcoal and deprived of flues, were often placed in cellars in communication with living and sleeping rooms. The gutters in some cases ran with a mixture of soap-suds and rain-water; the floors, of broken tiles, harboured grease, fat, and more repulsive deposits in other cases; and in most the walls and floors were incrusted with fermenting accumulations of humidity, grease, and sugar, which gave out a sickening smell. In some laboratories were found receptacles for the household slops, unsealed, with no siphon or trap, communicating directly with the sewers, and admitting sewer gas unimpeded into the workrooms. All these causes were fruitful in rendering these workshops sources of infection,—attacking not only the workmen, but not infrequently the employer himself, and the members of his family,—and sources of corruption for the alimentary products turned out of the workshops. The worst danger of all arose from the practice which prevailed of making the apprentices sleep in the work-rooms. In the Rue Gay-Lussac, in April last, three workmen or apprentices were suffocated by the fumes of the furnace by the side of which they slept. A few days later, of four pastrycooks' workmen and apprentices sleeping in a cellar, unventilated and unlighted, three were suffocated, and the employer himself, who slept above in the back shop on the ground floor, was nearly overcome by the carbonic acid fumes emanating from a furnace in the basement. In this basement the four unfortunate employés (three apprentices and one adult) slept two by two in beds placed in a hole opposite that containing the oven, both being scooped out of the earth under a passage to which access was given by an open gateway. The writer regards the "Bakehouses Regulation Act of 1863," as a piece of severe English legislation which France ought to follow in the main; on that Act was founded a Bill which the sub-committee proposed for adoption in Paris. The principal provisions of this Bill were that the laboratories and kitchens of such establishments should not be less than 9 ft. 4 in. high, should be lighted from the street or a wide court, and should be freely ventilated by air; waste water not to pass across the floor except in hermetically sealed pipes, properly trapped; every furnace to have a hood, conducting the smoke into a chimney not less than 12 in. by 10 in. in section, and extending

to the top of the house; and, wherever possible, a second tube of the same dimensions should be placed at the end opposite to the chimney. All sinks and openings for waste water to be trapped; there should always be a sufficient supply of water for drinking purposes; and no urinal, water-closet, or apparatus of like nature should be tolerated in any laboratory, kitchen, or bakehouse. All drain-pipes should be on the principle of "all to the sewer"; proper closets and urinals should be provided outside the workshop, all supplied with sufficient and proper apparatus, and trapped. Sleeping in places devoted to work, or in proximity to ovens, or in any underground room whatever, should be absolutely forbidden. Finally, the author calls attention to the desirability of limiting the number of persons sleeping in a room in proportion to its cubic contents, and to the immorality likely to result from apprentices and adults sleeping together indiscriminately.

Common Lodging Houses.

BY

P. Gordon Smith, F.R.I.B.A.

In approaching the subject of common lodging-houses it is necessary to come to a clear understanding as to what constitutes a common lodging-house; for outside the circle of officers and members of local governing bodies, there appears to be but an indistinct notion of what a common lodging-house really is. Not infrequently it is erroneously mixed up with that kind of model lodging-house which is now often advocated and provided as dwelling accommodation for the poorer classes of the labourer and artizan community in our cities and towns. Nor must the common lodging-house be confused with either the Seamen's Lodging House dealt with under the Merchant Shipping (Fishing Boats) Act, 1883 (Section 48), or with the night refuges provided by certain philanthropic individuals and societies. The application of the term common lodging-house has given rise to many questions, legal and otherwise, as to what houses ought to be classed as such, and be registered accordingly, and I feel sure that many of our friends, especially our foreign visitors, will need some explanation upon the point, the more so as common lodging-houses form the subject of several special legislative enactments.

In the absence of any complete statutory interpretation of the term, I will first explain that a common lodging-house is, in a certain limited sense, a sort of inn or hotel resorted to by certain of the very poor for temporary residential purposes, in which sleeping accommodation is provided in common, in one or several rooms, at a charge of 4*d.* or 6*d.* per night, and where those who resort to it cater for themselves as regards food, and ordinarily use one kitchen in common.

On several occasions efforts have been made to define with precision what constitutes a common lodging-house. It has been held that evidence that hawkers, itinerant picture-frame makers, chair-makers, musicians, bone-gatherers, and persons suspected of begging resorted to a house for lodgings and had their meals in the kitchen at the same table, paying 6*d.* per night each, is sufficient to establish that the house is a common lodging-house requiring to be registered under the Public Health Act, 1875. It will thus be seen that the question as to what is a common lodging-house depends, not so much upon the precise definition of the term as the consideration whether the circumstances of its occupation are such as involve supervision by the sanitary authority in order that its general cleanliness, ventilation, good ordering, &c., may be secured.

Common lodging-houses had existed in Great Britain for many years prior to legislative enactments for controlling them. In the "Report of the Poor Law Commissioners," 1842, the late Edwin Chadwick gave descriptive statements showing the horrible condition—sanitarily and socially—of the common lodging-houses in all parts of the kingdom, and showed how prolific they were in the propagation of disease and vice. But it was not until 1851 that Lord Ashley—better known later on as the philanthropic Earl of Shaftesbury—induced the Legislature to pass the Common Lodging Houses Act, an Act the preamble of which states that "it would tend "greatly to the comfort and welfare of many of Her Majesty's poorer "subjects if provision were made for the well-ordering of common "lodging-houses." That Act, however, and a subsequent one passed in 1853, were, so far as they related to common-lodging houses in the provinces, repealed by the Public Health Act, 1875; and, while the control and supervision of the common lodging-houses within the Metropolitan district (exclusive of the City) was allowed to remain in the hands of the police as enacted under the original Acts, that of the common lodging-houses throughout the rest of England and Wales was entrusted to the local sanitary authorities existing or constituted under that Public Health Act. As regards the City of London, the Common Lodging Houses Act of 1851 specially exempted the City from the operation of that Act, but the Commissioners of Sewers, acting as the Sanitary Authority for the City under the Sanitary Act, 1866, control houses let in lodgings, and have a code of regulations very similar in their general requirements to the bye-laws as to common lodging-houses in force in other sanitary districts.

That the subject of common lodging-houses is one of some importance as affecting directly and indirectly the whole community, will be better understood from the fact that, according to the evidence given in 1884 before the Royal Commission on the Housing of the Working Classes, as many as from 20,000 to 30,000 persons resort to them in London alone for lodgings every night, and some of the houses are certified to hold upwards of 500 lodgers. According to the Report of the Commissioners of Metropolitan Police for 1889 there were 988 common lodging-houses on the Register, making up, in the aggregate, accommodation for 33,964 persons.

From information kindly furnished to me by the officers of certain provincial towns, I am able to show the extent to which the system of common lodging-houses prevails in each of the towns named.

Name of Town.	No. of Common Lodging Houses on Register.	Aggregate No. of Beds in Common Lodging Houses on Register.	Largest number of Beds in any one Common Lodging House on Register.		
			For Men.*	For Women.*	For Married Couples.*
Birmingham -	86	1,861	186	13	12
Liverpool - -	878	9,895	172	66	230
Manchester - -	234	6,556	649	53	60
Salford - -	58	1,419	148	10	5
Bristol - -	51	1,006	106	6	8
Leicester - -	27	601	107	21	6
Nottingham -	50	762	50	21	10
Leeds - -	88	2,714	555	0	43
Newcastle-upon-Tyne.	96	1,053	30	12	10
Hull - -	53	1,333	90	8	16
Bradford -	52	930	128	19	13
Sheffield - -	40	1,273	85	20	14
Brighton - -	18	292	30		4
Portsmouth -	17	303	40	8	4

* In some instances the arrangements admit of the beds in these columns being interchangeable.

It will be well, perhaps, to briefly specify the accommodation that ought to be found in a complete common lodging-house. This should comprise an adequate day room for each sex, fitted with a fireplace and range suitable for the cooking of the lodgers' food, also a sufficient scullery or wash-house. Likewise dormitories for each sex, furnished with single bedsteads, bedding, &c. Lavatories, separate from the dormitories, are also necessary; and suitable and sufficient closet accommodation. In addition to the separate dormitory accommodation for each sex, cubicles or separate rooms may be provided for married couples, for, be it remembered, that any man and woman applying for such accommodation—and the Act of Parliament imposes no duty on the keeper of a common lodging-house in regard to the family relationship of the lodgers—may be received as such in a common lodging-house. In some few common lodging-houses a separate reading room has been provided, but this is comparatively exceptional. In several I have noticed that lockers are provided, in which those lodgers who may be regarded as regular customers can, for a trifling extra fee per week, leave their property with a certain amount of safety.

A few instances have come under my notice in which buildings have been specially erected as common lodging-houses, but these are comparatively rare. More frequently the common lodging-house is a capacious dwelling house which has ceased to serve its original purpose, owing to entire change in the character of the neighbourhood, and which has

been altered and adapted to serve its new purpose; but more often it is a warehouse or factory that has been altered and adapted to the purpose. These latter are generally the best kind of building for the purpose, as they usually have large rooms capable of fair light and ventilation. Some buildings of this sort now provide accommodation for 200 to 300 lodgers, and consequently involve a considerable amount of capital, and of attention and management on the part of the proprietor.

I propose to state briefly some of the chief conditions under which common lodging-houses are allowed to be carried on, and then to refer to a few of the more important of those conditions, with the object of ascertaining how far those conditions can be regarded as adequate and satisfactory.

The statutory laws require the controlling authority in every district to keep a register of the common lodging-houses within their districts, with the names and addresses of the keepers, and the number of lodgers which each house is authorised to receive. The keeper of every such house is required to have it registered, and the controlling authority are not to register any such house until they have had it inspected and approved for the purpose by some officer in their employ; they may further require, as a condition of registration, that the keeper shall produce a certificate of character; also that he shall exhibit the words "Registered Common Lodging House" in a conspicuous place outside the house. He may further be required to comply with sundry other enactments as to water supply, periodical lime washing of walls and ceilings, reporting any occurrence of infectious disease amongst the lodgers, the admission of the duly appointed officer to inspect the house, &c. In the provinces, moreover, every sanitary authority is required to make byelaws* for the following objects, such byelaws being confirmed by the Local Government Board in London before they can be put into operation:—For fixing and from time to time varying the number of lodgers who may be received into a common lodging-house, and for the separation of the sexes therein; for promoting cleanliness and ventilation in such houses; for the giving of notices and the taking precautions in the case of any infectious disease; and generally for the well ordering of such houses.

In the Metropolitan District corresponding regulations are issued by the Commissioners of Police, and the regulations now have to be confirmed by the Local Government Board.

It will be obvious that one of the chief features in the foregoing enactments which calls for careful attention, is that which requires the controlling authority to cause every common lodging-house to be inspected by some responsible officer in their employ, before placing it on the Register and certifying it as fit for a certain number of lodgers. For the guidance of sanitary authorities and their officers, the Local Government Board have issued a memorandum, of what should be looked for on the occasion of such inspection. In that memorandum it is pointed

* The model byelaws of the Local Government Board. Annotated edition. Knight & Co., London, 1890.

out that the house should possess the conditions of wholesomeness needed for dwelling houses in general; and that it should further have arrangements fitting it for its special purpose of receiving a given number of lodgers. The details as to general wholesomeness are set out, and the method of determining the accommodation is then given. The numbers for which the house and each sleeping room may be registered will depend, partly upon the dimensions of the rooms and their facilities for ventilation and partly upon the amount of accommodation of other kinds. In rooms of ordinary construction to be used for sleeping, where there are the usual means of ventilation by windows and chimneys, about 300 cubic feet will be a proper standard of space to secure to each person; but in many rooms it will be right to appoint a larger space, and this can only be determined on inspection of the particular room. The house should possess kitchen and day-room accommodation apart from its bedrooms, and the sufficiency of this will have to be attended to. Rooms that are partially underground may not be improper for day rooms, but should not be registered for use as bedrooms. The amount of water supply, closet or privy accommodation, and the provision of refuse receptacles should be proportionate to the numbers for which the house is to be registered. If the water is not supplied from works with constant service, a quantity should be secured for daily use on a scale, per registered inmate, of not less than 10 gallons a day where there are waterclosets, or five gallons a day where there are dry closets. For every 20 registered lodgers a separate closet or privy should be required. The washing accommodation should, wherever practicable, be in a special place and not be in the bedrooms; and the basins for personal washing should be fixed and have water taps and discharge pipes connected with them.

Time precludes us from considering all these particulars in detail, but there appear to me to be one or two important points that deserve special attention. There is, for instance, the question of fixing the number of lodgers to be received into each particular common lodging-house; and there is the question of the separation of the sexes, and the provision for married couples.

As regards the methods by which the accommodation of a common lodging-house is fixed, this should depend not only upon the numbers which the dormitories may be calculated to hold, but upon the provision of adequate day-room space for the lodgers. In fixing the accommodation of the dormitories, it is usual to reckon not less than 300 cubic to each adult lodger. Although this minimum amount is a very small one, it has been arrived at by a careful regard partly for health considerations and partly in view of the difficulties of lodgment in the metropolis and other populous places. This standard, however, should under no circumstances be diminished; it is only where there are at least the usual means of through ventilation by proper windows and chimney flues that so small an allowance is permissible; but where there are only indifferent means of ventilation, or where the room is of unusual height, or where the room is used by day as well as by night, a larger amount of space per lodger ought ordinarily to be required. In

the case of children under 10 years of age, it is usual to reckon two such children as one person. Children, however, are not by any means numerous in common lodging-houses.

Much as I should like to see a larger minimum standard of space allowed to each lodger, I am not prepared to suggest that the amounts above referred to should be increased, since the difficulties of securing larger amounts would, I believe, be practically insurmountable; but I do think that the utmost care should be exercised to insure that where only those small amounts of space are afforded, all available means of ventilation are not only provided but are made use of; and it is in this respect that the usefulness of constant inspection will be most evident. At the same time it must continually be borne in mind that the ordinary *habitué* of a common lodging-house is an individual who cares nothing whatever for ventilation or fresh air, provided he is warm; that he is often under-fed, and but poorly clad; and that in wet weather his clothing is rarely dry. Under such conditions it is not surprising if he selects the lodging-house where the dormitory is (to him) the most comfortable and free from cold draughts and fresh air. The keeper, too, has the interest of his customers at heart, and he gladly sees the street-hawker, organ-grinder, pedlar, and other customer come night after night to his establishment; in fact, like every good hotel-keeper, he strives to make his customers comfortable according to their individual ideas of comfort; otherwise, if he has a large establishment, he may find, perhaps, a hundred of his beds empty, and this would inflict on him a loss of some 10*l.* or more a week; and, however important we may consider the ample supply of fresh air in the dormitories of these lodging-houses, we have to take care not to apply the rules as to ventilation with undue rigour, or in a manner that would indeed drive away those whose comfort it is our desire to increase.

The question of warmth is, of course, closely associated with ventilation, and if the lodging-house keeper invariably had a reserve of bed clothing and blankets that could be resorted to in cold weather, there might possibly be rather less difficulty with regard to ventilation. But while the reserve of blankets is rarely large (and there is no great encouragement to be very profuse in their supply, since the losses by theft, both in regard to sheets and blankets, are considerable, for they get torn up for use as underclothing or to serve as bandages for wounds, &c.), the difficulty of getting fresh air into the dormitories, unless it were first warmed, will always be great, since there is scarcely any ventilator that will escape obstruction unless it be wholly invisible and inaccessible. In the day time the windows of the dormitories have to be kept fully open for a specified time morning and afternoon, but means for the constant ventilation of the dormitories when occupied at night are indispensable, and the less visible they are the better. Compared with the amount of space per lodger prescribed by the police regulations of Paris and Berlin, our own 300 cubic feet is decidedly small. In Paris the lodging-houses under systematic supervision are required by the police to have in each occupied room a minimum height of 2½ metres, and each lodger 14 cubic metres of air space, which is equal to some 480 cubic feet. In Berlin the police

regulations applicable to lodging-houses under their inspection require a minimum amount of 3 square metres of floor space and 10 cubic metres of air space, equal to about 350 cubic feet for each lodger, this latter being reduced to one half in the case of children under 6 years of age, and to two-thirds for children between 6 and 14 years old.

The separation of the sexes in common lodging-houses is a further point which, apart from its moral aspect, is not without an important bearing on the general question of hygiene. It is a matter dealt with by byelaws in the provinces and by police regulations in the metropolis. In the byelaws it is usual, except as regards husband and wife, to prohibit any person of the male sex above 10 years of age from using or occupying a room used or occupied as a sleeping apartment by persons of the female sex, and similarly to prohibit any person of the female sex from using or occupying a room used or occupied as a sleeping apartment by persons of the male sex above 10 years of age. These rules do not interfere with the children of tender years remaining with their parents at night. How far it is desirable to separate the sexes elsewhere than in the common dormitories may be open to question, but as a matter of fact it is practically never done, except in those common lodging-houses which are intended for one sex only. In the others; men and women associate freely in the common rooms, where clothes are mended and often washed and dried, unlimited cooking goes on, and meals are taken. I assume that the Legislature intended the separation of the sexes to be applicable only as regards the common dormitories, otherwise specific arrangements would be made, as they easily might be, for the same separation in the day rooms. The separation of the sexes does not, of course, apply to married couples, since man and wife could no more be lawfully separated in a common lodging-house, where they pay for their accommodation, than in an ordinary inn or hotel, provided the accommodation afforded be such as will conform to ordinary rules of decency, and is duly certified by the responsible authority. That this accommodation may be, and frequently is, improperly used, will not, I think, be denied, but this point is beyond the scope of the present paper.

Cottage Homes for the Industrial Classes.

BY

ROWLAND PLUMBE, F.R.I.B.A., F.S.I.

In common with many experts who have given great attention to the subject, I hold strongly the opinion that every effort should be made to prevent any further concentration of industrial homes in the already overcrowded streets of the central districts of the metropolis. These residences should be scattered widely, and should be situated as far as practicable from the already congested central districts, and the working classes should be induced to spend their hours of rest and recreation in the purer and more abundant light and air of the suburbs. Especially

is this desirable in the case of the wives and children, even though quarters may be found in the best built and most advantageously situated flats in the many blocks of model dwellings that have been provided so largely of late. This opinion is strongly confirmed by the view taken in an article contained in the recently published volumes of Mr. Charles Booth's valuable work on the "Labour and Life of the People." It is written by Miss Octavia Hill, under the heading "Blocks of Model Dwellings," Vol. 2, Sec. 2, Fol. 262, "Influence on Character." The article is much too long to quote on the present occasion, but is strongly in favour of separate cottage homes, while the many objections to block dwellings are forcibly demonstrated.

In building new districts, social and class prejudices have hitherto prevented the richer and more cultured classes of the population from living in close proximity to those whom they consider below them in social standing. This prejudice is probably as strong also on the part of the poorer population, and so each class prefers to keep to itself. These tendencies are unfortunate, and in the present state of society, seemingly insurmountable. The great difference in the value of land and property in fashionable and in poorer neighbourhoods also prevents proximity of the classes; still, in providing estates for the industrial population, an attempt should be made to get as great a mixture and variety in the social scale of the inhabitants as is practicable.

Therefore in providing model villages for the artizan and industrial class, I think that provision should be made, and attractions should be laid out, for all sorts and conditions of inhabitants likely to reside in them. The site should be a salubrious one, all natural defects of soil and climate should be overcome as far as possible. The locality should be easy of access to large industrial centres, with cheap and frequent means of transit by road and rail. It should be laid out with wide and well-made roads and footways, which should be planted with suitable trees, and made as attractive as possible. The drainage and sanitary arrangements should, of course, be perfect; each home should be self-contained, and should be bright, cheerful, well arranged, commodious, and healthy; the houses well set back from the public footway, with gardens in front and a good drying ground in the rear, which could also be laid out as an additional garden or recreation ground, and where under proper regulations domestic animals and poultry might be kept.

The houses should be varied in plan and accommodation to suit the habits of all classes, and of the different sized families likely to occupy them. They should, of course, be substantially built, and every sanitary requirement should be provided. They should be decorated and finished in a pleasing manner to suit the best taste of the occupants, and a general air of comfort, brightness, cleanliness, and cheerfulness should be given to them, as also to the estate generally. Open spaces for recreation and for garden allotments should be provided. Pressure should be brought to bear upon the local authorities so that the provisions of the Education Act, the Baths and Wash Houses Act, the Public Libraries Act, and all other beneficial legislation of a like character may be carried out, and suitable buildings for the same should be provided. Churches, parish rooms, public board schools, polytechnic institutes, coffee taverns, and

clubs of all kinds should also be provided; a sufficient provision of shops should likewise be built in suitable positions; and the question of public-house accommodation should also be most carefully considered, and (if provided) not placed in positions likely to create discomfort and disorder.

The classes of people inhabiting such estates should pay weekly rents, and habits of thrift should be encouraged by always insisting that the rents should be paid at least one week in advance. The inhabitants should also be encouraged to invest even small amounts in the capital of the company, so that they may co-operate in its undertakings. Houses should not be sold to individuals, as in that case abuses at once spring up, but the whole estate should be owned and managed by one company, the tenants being shareholders wherever possible. The inhabitants should be encouraged to take an interest in the maintenance of the company's property, and forms should be provided on which should be stated any want of repair or other matter requiring attention, these should be left at the estate office, and a staff should be appointed to attend to the same. The company should maintain and manage a proper staff of officials and workmen to attend to all matters of repair and maintenance. It should be established on a proper business footing, and financially it should be so managed as to pay a remunerative rate of interest to its investors. However philanthropic the motives of the promoters may be, there should be no sense of favour to the inhabitants, who should be encouraged to feel that they are paying a fair rental for the accommodation provided. The company should aim at paying a dividend on each estate of 5 per cent.; but it is highly probable that as such property extends and the security increases in value, the public would be found willing to invest in it at a considerably lower rate.

Now the foregoing very incomplete and sketchy description of a model cottage village may seem to many overdrawn, if not altogether chimerical. In order to prove that this is not so, I propose to give a short account of the latest village of the kind that has been actually erected under my design and superintendence. This estate, having an area of 100 acres, is called Noel Park, and is situate at Wood Green, a suburb in the N.E. district, about 10 minutes' walk from the Hornsey and Wood Green Stations of the Great Northern Railway. Green Lanes and Noel Park Station on the Great Eastern Railway is actually on the estate, and steam tramways run along the main road on which it is situate.* The estate has a very gentle slope towards Tottenham; the soil is the usual dense clay found in the outlying parts of London on the north side of the river, which is always much improved by roadmaking, planting, paving, and draining.

The main avenue is 60 feet wide; other avenues are 50 feet wide, and the cross streets 40 feet wide. As the houses are built the roads are completely made up, channelled, and curbed, and the footways are entirely paved with York stone, and planted at regular intervals (mostly with plane trees). At present it is contemplated to provide a large open space as a recreation ground.

* A general plan of the estate, as proposed to be completed, was exhibited by the author.

The general drainage of the estate, in accordance with the requirements of the local authorities, has been arranged on the dual system, the rain and surface water being kept separate from the sewage. No drains run through the houses, back drains with intercepting manholes, specially ventilated, being provided for all terraces. The system of ventilation of sewers has specially been considered, the usual ventilating openings in the roads are arranged to act simply as inlet ventilators, the sewers having manholes at short distances apart, with specially designed valves and upcast ventilation shafts carried above the houses. Automatic flushing tanks are also provided.

In laying out the estate, care has been taken that all houses are set well back from the road, all having front gardens. The objectionable practice of bringing the corner houses out to the pavement line of the return roads is in all cases avoided, the corner houses of the terraces being set back, and specially designed and planned so as to form an architectural adornment to the terrace of which they form a part. There will be about 2,500 houses and shops built on this estate, mostly of five different classes. About 1,305 houses are already built, and are nearly all occupied.

The first class houses are built on plots having a frontage of about 16 feet wide and 85 feet deep, with a floor area of about 1,065 feet on both floors, containing eight rooms, including the scullery. Each house is provided with two sitting-rooms, kitchen, wash-house, and four bedrooms, also a back entrance, with coal cellar, larder, washing-copper, and water-closet, and in most cases an additional water-closet on the chamber floor. The houses are let at a rental of from 11*s.* to 11*s.* 6*d.* per week, including all rates and taxes, which are paid by the company. The greater number of these houses are provided with a water-closet on the first floor; and in such cases the back rooms are fitted up as kitchens and sculleries complete, so that they may accommodate two families if required.

The second class houses are built on plots having a frontage of about 15 feet 6 inches by a depth of 80 feet. The floor area is 936 feet, containing seven rooms, there being only three bedrooms on the first floor. The other accommodation is similar to that last described, except that there is no upstairs water-closet. The weekly rental of these houses is about 10*s.* per week.

The third class houses are built on plots having a frontage of 15 feet by a depth of about 70 feet, and possess a floor area of about 800 feet, containing six rooms, three being bedrooms. The weekly rental of these houses is about 9*s.* per week.

The fourth class houses are built on plots having frontages of about 14 feet 6 inches by a depth of about 70 feet, with a floor area of 660 feet, containing five rooms, there being two bedrooms on the first floor. The rental of these houses is about 7*s.* 6*d.* per week.

The fifth class houses are built on plots having a frontage of 13 feet by a depth of 60 feet. The floor area is about 470 feet, containing a front living room, with kitchen and small wash-house behind, with two bedrooms over. The rental of these houses is about 6*s.* per week.

In addition to the various classes of houses just described, an endeavour has been made to provide for still further varied requirements by adapting them as flats, two stories high, for two families. In the case of third class houses the staircase is shut-off, the upper floor being arranged as a separate dwelling, consisting of a living room and two bedrooms, with an outside staircase down to the back garden, the closet and wash-house being held in common. These are let at 4*s.* 6*d.* per week the lower flat, and 5*s.* per week the upper flat. Advantage is taken of the corner houses to get separate entrances at the side. Second class houses also are similarly arranged. Each flat has its own scullery, wash-house, and w.c. The rental of these houses is 5*s.* a week for each floor, and 6*s.* to 7*s.* a week for houses with special accommodation. First-class houses have been arranged in the same way. The frontages are extended from 16 feet to 19 feet, and entirely separate entrances and outside doors are given to each flat, a small additional bedroom being obtained on the first floor. The rental of these houses is 7*s.* a week ground-floor, and 8*s.* a week for first-floor flats. The corner houses have an extra floor, and are let at special rates, viz., 10*s.* 6*d.* for the first and second floors. It is proposed that by far the largest number of houses built should be of the smaller class, in order to encourage the industrial classes in the effort to avail themselves of houses at a rental which will not make it necessary to take in lodgers.

In the general planning of these houses the company does not profess to carry out any specially new arrangement; the type, with the exception of the fifth-class houses and double flats, being that which seems to have been universally adopted in all town and suburban terrace-dwellings, as giving the greatest accommodation at the cheapest rate; where however, any special requirement has to be met, as (for instance) in the case of shallow, corner and other irregularly shaped plots, the architect has availed himself of the opportunity to design plans of almost every variety of arrangement; but for the general terrace plans the Board has not found it practicable to adopt a more convenient and economical plan than that shown.

In the general view of the terraces of the first and second-class houses, a feature in the design is made of the corner houses; and with a view of breaking up the monotony of the long lines which terraces in streets produce, specially designed features are introduced at intervals so as to break up and improve the sky-line of the buildings; advantage is also taken of these features to improve the accommodation of the houses, so that a return may be obtained for the extra outlay by an increased rent, which is readily obtained in such cases.

The houses are all built with a layer of concrete over the whole area of the buildings; the walls are of brickwork, the party walls being hollow or 14″ thick, to prevent the passage of sound between the tenements; slate and cement damp-proof courses are used; the walls are faced with red and yellow bricks, with terra cotta or artificial stone cills and flower guards; the roofs are mostly slated, but to give variety many are tiled; the whole being built with the best materials and designed to have a bright and cheerful appearance. The space under the ground floor is specially ventilated, as are also all the rooms, Tobin

tubes and deep inner beads to windows being provided to each room. There is a constant water supply, and no cisterns are used except the water waste preventors to the water-closets. The sanitary arrangements are of approved yet simple character, all waste and other pipes being discharged over open trapped yard gullies. No soil or rain water drains run through the houses, as the pipes are carried along the back gardens and are provided with ventilated manholes for inspection and flushing at suitable distances. There are also similar manholes at the junction of these drains with the pipe sewers in roads.

The general requirements of the inhabitants have been studied. Already the estate has been formed into a separate parish, and a church has been built holding 850 on the ground floor, with mission hall, parish rooms, and all the usual church societies. Building sites have been offered for churches of other denominations; a fine board school has also been built; various social clubs already exist, as also cricket, foot-ball, and other clubs; space is reserved for a public hall, should it ever be required, and every facility will also be given for the erection of polytechnics and other buildings for technical education; also for free libraries, swimming baths, and other similar buildings, whenever the authorities are ready to put the various Acts of Parliament providing these buildings into operation. On the other estates, halls for the use of the inhabitants have been built, but they are so little used, that there is but little encouragement to repeat the experiment. In certain parts shops have been built, also stables, and space is reserved for workshops and laundries.

Although it is not thought advisable to interfere directly with the conduct of the various societies that have sprung up, yet the managers of the estate are always desirous of helping them forward when once started by the tenants. With this object prizes are given, and other facilities granted in aid of the same. Some of the land not yet built upon is used for cricket and recreation grounds, and also for allotment gardens, and it is hoped to reserve permanently enough land for this purpose. In order to promote thrift and self-respect, the estate is managed on the lines first indicated in the first part of this paper, and no public-houses or pawnbrokers shops are allowed on the estate.

The estate is occupied by young married people, a few retired tradesmen with moderate incomes, travellers, warehousemen and clerks, railway employées, tradesmen's assistants of all kinds, artizans of all classes, cabmen, letter carriers, labourers, policemen, pensioners, &c. The inhabitants are healthy, and but few complaints are made. The death-rate on the company's estates from January to the end of June 1891 was about 14·41 per 1,000, as compared with a death-rate in the general district of about 15·25 per 1,000.

In respect to co-operation by the tenants in the development of the company, but little can, at present, be said. Every opportunity is given to them to invest; only a few shares are, however, held by them.

It is believed that this estate would have been by this time completed had proper railway facilities been provided. There are cheap workmen's trains from the Great Eastern Station on the estate, and

from the stations on the Great Northern Railway, not far distant, but these early morning trains by no means cover the necessities of the industrial population. It is a fact not generally known that, except on the Midland Railway, the third-class passenger, who is packed closely in his carriage, and allowed to travel but once, backwards and forwards, on six days of the week, actually pays, on an average, about as much for his railway fares as a first-class passenger who, having a season ticket can travel as often as he likes in comfort, and has also the right to travel on Sundays.

That there is nothing impracticable in the granting of third-class season tickets, is shown by the example of the Midland Railway. This line, as is well known, has no second-class, but its first and third-class passengers are treated with perfect equality with regard to season tickets. What is urgently needed is cheap workmen's trains throughout the day, and failing this, the issue of third-class season tickets, at cheap rates, in proportion to the other classes.

In regard to general statistics, it may be interesting to know that an average of about 25 houses per acre are built upon the estate, including space for roads, and that the population is at the rate of about seven people per house, so that when it is completed it will contain a population of about 17,500. There will then be over five miles of roads and streets formed. The outlay including the land, up to the present time has been about 460,000*l.*, and the net income is now about 21,000*l.*, so that the estate (though only about half developed) already pays over 4½ per cent. The estate is one of four held by the Artizans, Labourers', and General Dwellings' Company (which holds other properties), whose assets are over 2,000,000*l.* sterling. The company has for years paid a dividend of 5 per cent. to its original shareholders, and the shares are now issued at a premium of about 10 per cent. to pay 4½ per cent. dividend. The market price of the stock is above this.

I trust I have now demonstrated the possibility of providing for our industrial classes bright, cheerful, well arranged, commodious, healthy and self-contained cottage homes under the best sanitary conditions, at a cost which will adequately remunerate the promoters of such good work.

Block Dwellings for the Industrial Classes.

BY

JOHN F. J. SYKES, B.Sc., M.B., Medical Officer of Health for St. Pancras.

Of all the classes into which the people may be divided, those that give rise to the most difficult sanitary, social, and economic problems are, proceeding from below upwards, the pauper, the residuum, and the working classes. The housing of the pauper is undertaken by the State; the distinguished efforts of Miss Octavia Hill and other philanthropists are directed towards ameliorating the dwellings and habits

of the residuum, the most difficult class to deal with from the variability of type and condition; whilst public companies and private individuals are engaged in constructing improved dwellings to house the working classes and gather them out from herding in tenement houses among the residuum.

In order to keep within reasonable bounds it is necessary to limit working-class dwellings to unfurnished dwellings consisting of from one to three, or, possibly, four rooms, generally let on weekly tenancy, at rentals of from 2*s.* or 2*s.* 6*d.* to 7*s.* 6*d.*, or perhaps even to 10*s.* This will include tenement, cottage, and block dwellings.

Dwellings in "made down" or "tenement" houses, houses originally constructed for occupation by one family, but let out in separate tenements to two or more families, have for years engaged the efforts of sanitarians for their improvement by adaptation, or their displacement by demolition.

The type of the true cottage-dwelling is the cottage with or without upper floor, self-contained, and occupied by only one family, although it is not difficult to apply this term too narrowly. These dwellings still exist in large numbers in the metropolis, but their construction and surroundings are the very antithesis of suburban cottage-dwellings, and they may in most cases be added to the category of desirable demolitions.

Block dwellings, on the other hand, are understood to comprise sets of dwellings super-imposed one above the other on the same base, possessing a common stair, and differing only from residential flats in length of tenancy, rental, and accommodation. Under the present inadequate restrictions as to construction, not a few recently constructed dwellings of this type are nearly as unsatisfactory as the dwellings they have displaced. But the majority are well-built, and it only requires the framing of bye-laws, and their due enforcement in the construction of this class of buildings, to ensure that in future all shall be constructed with due regard to health. This is a subject which urgently needs the attention of the legislature.

In Mr. Charles Booth's recently published work on Labour and Life of the People, Vol. II., London, the existing block dwellings of the metropolis have been classed in various categories, of which the following is a summary:—

Light, Air, and Sanitation.	Blocks.	Tenements.	Population.
"Very bad" and "bad" - -	115	6,859	37,911
"Fair," "good," and "very good" -	360	28,921	151,197
TOTAL - -	475	35,780	189,108

To provide for increase of population, cottage-dwellings on new estates in the suburbs or the country, coupled with cheap and expeditious transit, are most desirable.

But in order to promote the health and comfort of town dwellings, the demolition of permanently insanitary and overcrowded dwellings and of houses falling into dilapidation and decay is necessary, and it is then a question of utilising the site. If the site is to be devoted to other purposes, then provision for a number of persons equal to the population displaced may be made by the erection of cottage-dwellings in the suburbs, for instance, in demolitions made for railway purposes. If, on the other hand, new and improved dwellings are to be erected upon the site, these may be either cottage or block dwellings.

The effect of clearing small areas appears to be, firstly, to displace all grades of occupants alike, and to re-distribute them in the surrounding neighbourhoods, and, secondly, when the new and improved dwellings have been erected, to set up a reverse current by which the better grades are drawn into the new buildings, leaving the indifferent and inferior in occupation of the older buildings on the areas surrounding the site cleared; whether the new buildings be urban or suburban the same process of re-allocation takes place.

It cannot be doubted that the air and the surroundings of the suburb are more beneficial to the health, especially of growing children, than those of the town; but the disadvantages of distance make themselves appreciably felt in the expenditure of time, energy, and money on travelling, the relaxation of family ties, and the curtailment of home life, the husband and other members of the family taking meals away from home, the frequent loss of work if the exigencies of occupation require the worker to be at short call, the long absence in occupations entailing exceptionally early or late hours, the increased expenditure in the family marketing, the extra cost, &c., if other members of the family besides the husband work away from home, and other disadvantages.

The success of suburban villages shows that these disadvantages may be overcome, and that the conditions may be made to fit the occupations of certain classes; but, on the other hand, the evidence of representative working men before the Select Committee of the House of Commons inquiring into artizans' and labourers' dwellings went to show that to many classes of workmen the disadvantages of distance were insuperable, and these classes must be housed upon the cleared sites, whether cleared by public undertaking or by private enterprise.

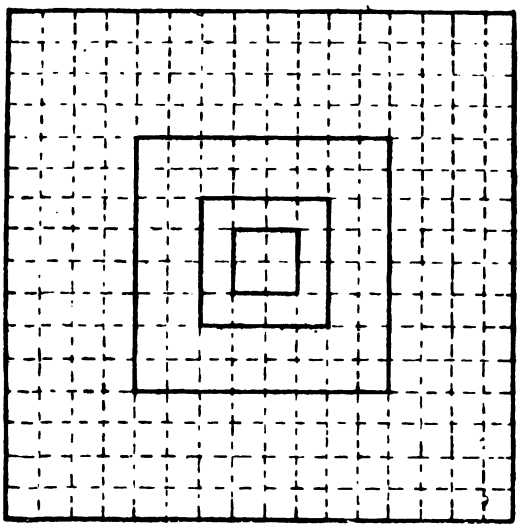
It then becomes a question whether small or large buildings should be erected upon the site. To erect cottage-dwellings in the centre of cities would be costly, and would place the rental beyond the reach of the classes for whom they are intended. Besides, the overcrowded condition would be reproduced in housing the same number of persons on the same area, or a large proportion must remain unprovided for.

The object to be aimed at is to diminish the crowding by expanding the population through a greater amount of cubic space with increased light and air; and, whilst reconstructing, to provide improved sanitary arrangements, and to so dispose the dwellings as to enable them to be effectually supervised and protected.

The first consideration, therefore, is the amount of cubic space enclosable on square space.

The square space required for a cube to stand upon so that it may be surrounded by a square open area equal in width to half its height, (assuming that contiguous cubes would provide the other half, so as to complete a width of surrounding area equal to the whole height) would be twice the length of the base or side of the cube squared, $(2\ S)^2$: whilst the capacity of the cube would be the length of the side cubed, $(S)^3$.

A



Length of Side (S).	Cubic Capacity $(S)^3$.	Square Space required $(2\ S)^2$.
10 feet.	1,000 cubic feet.	400 square feet.
20 „	8,000 „	1,600 „
30 „	27,000 „	3,600 „
40 „	64,000 „	6,400 „
50 „	125,000 „	10,000 „
60 „	216,000 „	14,400 „
70 „	343,000 „	19,600 „

So that a cube containing 64,000 cubic feet would require only 16 times instead of 64 times the area of square space required by a cube containing 1,000 cubic feet,—a simple and striking illustration of the gain of cubic space upon square space by increase in size under similar conditions. The effect upon the construction of buildings, although following parallel lines, is not such a simple deduction; but upon the same area and under the same conditions a much larger proportion of cubic space to square space may be enclosed by increasing the size of building, and the dwelling space may be further increased by the economy of staircase space and terrace construction in erecting rows of blocks.

In order to estimate the comparative amount of cubic space enclosable in actual building it is desirable to briefly consider the height, depth, length, and spacing of blocks.

The height of rooms must be proportionate to size for the purpose of lighting and ventilation. Windows materially influence the height; it is undesirable to have windows that cannot conveniently be seen through or be easily manipulated. A window six feet high is ample, and if the bottom rail be not more than 3½ feet from the floor, and the top nearly reach the ceiling, as it should do, we have a height of over 9½ feet. Even half underground rooms are restricted to a height of 7 feet, a very minimum. Sir Douglas Galton considers it desirable in small rooms to obtain a height of 10 feet to facilitate ventilation. Increase of height beyond what is necessary and desirable increases the number of stairs required to reach the next floor and diminishes the number of storeys, or renders it necessary to increase the elevation, in either case increasing the proportionate cost. So that about 10 feet may be assumed as a good standard for moderate sized dwelling rooms. Whatever the height adopted, it is not desirable that the rooms in the upper storeys of a block should be of less height than those of the lower.

The number of storeys is obviously governed by the height of the rooms and the total height of the building.

The total height of blocks is limited by many considerations. It is highly desirable, almost necessary, that a street should run between every alternate row of blocks. Although in the metropolis in old streets, houses can be and are being constantly raised to heights out of all proportion to the intervening space, no new street can be formed of less width than 40 feet, and no new building which shall exceed in height the width of the street can be erected on the side of a street less than 50 feet wide. Last year only, a clause was introduced into a General Powers Act of the County Council limiting the total height of buildings to 90 feet. So that, provided it does not exceed 90 feet, the height of buildings is under no legislative control, except in new streets between 40 and 50 feet wide. With increased height, difficulty of access to the topmost storeys increases, and the rentals tend to diminish. There is additional cost for increased strength of construction, and the gain in cubic space in proportion to square space tends to diminish. Beyond a certain height lifts would be required, the construction and working of which would add to the cost, and endanger the lives of the large infant population prevalent in these buildings. There is a height beyond which it is on all counts false economy to build. So that blocks would be limited to a height of from 40 to 60 feet, or to four or six storeys of 10 feet; practically the latter is about the present maximum limit.

The depth of a room according to Trélat should not exceed one-and-a-half times the height from the floor to the top of the window. This would give an incidence of 30° to the rays of light reaching that portion of the floor furthest from the window; if an angle of 45° were required the depth would equal the height. According to the latter, a room 10 feet high would be 10 feet, and to the former 15 feet deep as a maximum. The depth of ordinary double fronted terrace houses may be roughly taken as varying from 25 to 35 feet, and by doubling the maximum assumed depth of a single room, as above, a depth of 30 feet is reached.

There is no advantage in constructing rooms for the working class families of a width or length in the line of frontage requiring more than one window to adequately light them, and it is highly desirable that they should not exceed a length that can be adequately lighted at the sides. The incidence of light entering horizontally impinges on the lateral walls at an angle of 45°, the dark angles on each side of the window diminishing or increasing as the side walls approach or recede, and the width of the room must be governed more by the width and situation of the window than by the height or depth of the room.

Block dwellings encourage increased length as well as depth of rooms on account of the greater economy of ground space obtained in many storeyed as contrasted with single-storeyed buildings. Firstly, because the initial ground space occupied by the increased area of the building serves a number of storeys, whereas in single-storeyed buildings increased area of the building requires a correspondingly increased amount of ground to be covered for each separate building. Secondly, because the greater the area of building served by a single staircase, the greater the economy of staircase space. So that the length of a single block is limited by the number of consecutive rooms accessible from the same staircase.

The healthiest condition of construction is that in which through ventilation, or perflation, may be obtained. Blocks may be so constructed as more or less to reproduce one of the bad features of back to back houses. Corridors and lateral passages are undesirable, and it is also undesirable that bedrooms should become passage ways to rooms beyond; these considerations limit the number of consecutive dwelling-rooms on either side of the staircase.

The length of a row of blocks is limited by the length of the ground area, but it is also desirable that the blocks should not be more numerous than the superintendent can efficiently supervise and protect.

It is unnecessary to enter here into the disadvantages and unhealthiness of single-fronted dwellings, especially when erected in terraces, from the absence of rear space and of through ventilation or interior perflation. This is exhibited in its worst form in back to back houses, when two rows of single-fronted dwellings are erected with their fronts facing in opposite directions, the same back party-wall serving both rows, and a public street running along each front. Given the principle that the fronts of all buildings should face open spaces proportionate to the height of the buildings and along their whole length, and that the rear space should not only remain open, but should not be converted into a public thoroughfare (a most important point), there is no economy of ground space in constructing single-fronted buildings, whether they are back-to-back or not.

Out-buildings, towers, or projections abutting at right-angles to the line of frontage are objectionable by impeding light and air on either side, in proportion to the distance they advance from the main front, and according to orientation. On the other hand, there is great advantage in being able to obtain cross-ventilation and cross-light between the main building and the projection when this contains the sanitary

arrangements. Where such projections are constructed an additional amount of open space should be required in proportion to the projection, and the projection should not be allowed to advance so as to obstruct exterior perflation, and on no account so far as to close up the stretch of open space, whether in front or at the rear, forming a cul-de-sac in either case, the one of the courtyard and the other of the street, nor should terraces be permitted to abut directly upon one another at right angles. Orientation also will necessarily affect the lighting, the least obstruction to the sun's rays being presented by buildings running north and south.

Terraces of blocks being double-fronted, both rear and front should face open spaces proportionate in width to the height of the buildings. The question whether this proportion should be equal to the height, according to Dr. Clement; or to one-and-a-half times the height, according to Dr. Trélat; or should vary with latitude and orientation, according to Adolphe Vogt; or with city zones according to Von Gruber; was discussed at the Vienna Congress, and remains undecided. But that the width of open space on both frontages should be proportionate to the height of the dwellings is accepted, and anything less than a width equal to the height of the building above ground level would be unacceptable to hygienists.

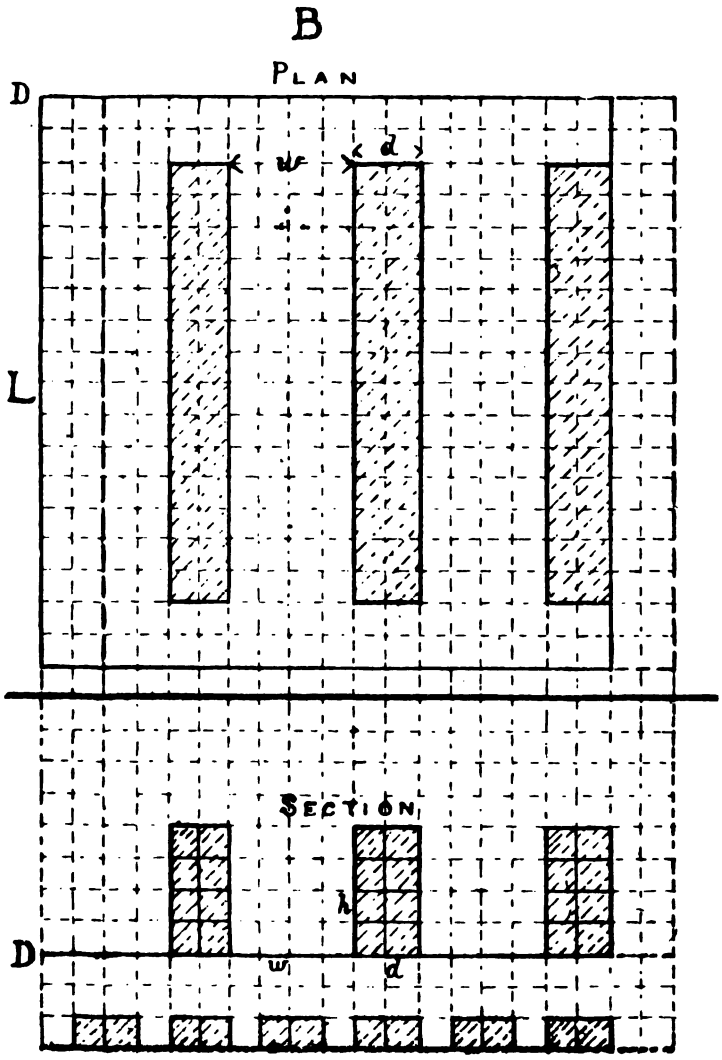
The reckless manner in which at the present moment blocks of dwellings are being erected, with an utter disregard for this provision of light and air, calls most urgently for legislative restrictions in the construction of this class of buildings.

Present metropolitan legislation, so far as front space is concerned, only affects buildings in new streets, and new streets are few and far between in London; furthermore, it does not affect streets over 50 feet wide. So far as rear space is concerned, it only provides for a space 10 feet wide extending the length of rear fronts of buildings from 15 to 30 feet wide, 450 square feet being held to suffice for any length over 30 feet, but even this inadequate provision is inoperative when the site has previously been occupied in whole or in part by buildings; and, furthermore, when it does become operative it permits the whole of the open space to be built over up to the level of the first floor.

The growing antipathy of philanthropists to block dwellings is greatly justified by the dread of the ultimate effects of the total absence of any restrictions as to this class of buildings erected on old sites. The crusade against insanitary dwellings, without adequate restrictions upon the buildings that will replace them, may make the last state worse than the first. The attitude of antipathy must become one of sympathy, and the efforts of sanitarians and philanthropists should rather be directed to righting the wrong as soon as possible.

Having briefly considered the conditions of construction, we may now proceed to calculate the relative amount of cubic space enclosable on a rectangular area under varying conditions of height of building. Such a calculation would only apply to a small area, at the most limited to a few acres, for in a larger area other factors would be introduced which are beyond present consideration.

When superimposing dwellings one above the other, for every additional floor or storey the floor area of the storey is economised, and it is only necessary to provide space equal to the areas of the two fronts. One interspace will serve the opposed fronts of two blocks, that is, each block will have on either side of it one-half the amount of open space due to it, and the width of open space to be calculated with each block will be proportionate to the height and number of the storeys; the same applies to the ends of the rows of blocks. Therefore, the depth of the block, plus the width of the open space on one side, will equal the depth of total space occupied by one block, and this divided into the total depth of the area will give the number of blocks. Assuming that the length of the blocks is equal to the length of the area, less the space required at each end, and that each storey or stage is of the same height, then the cubic capacity of one block multiplied by the number of blocks will give the total cubic space enclosable.



Let it be assumed that the total area is 500 feet by 250 (about 2·87 acres) the former being the depth, the latter the length coinciding with the long axis of the buildings; that the depth of each block is 30 feet, allowing two rooms each of 15 feet deep; that the height of each floor is 10 feet; and that the width of intermediate space is equal to the height of the blocks.

(1.) The first step is to find the number of rows of blocks.

Let D = total depth of area;
d = depth of one block;
h = height of one storey;
n = number of storeys;
w = width of one interspace;

then w = h and $\frac{D}{d + nh}$ = number of blocks.

If 1 storey high - $\frac{D}{d + h} = \frac{500}{30 + 10} = 12{\cdot}500$ rows of blocks.
„ 2 storeys „ - $\frac{D}{d + 2h} = \frac{500}{30 + 20} = 10{\cdot}000$ „
„ 3 „ „ - $\frac{D}{d + 3h} = \frac{500}{30 + 30} = 8{\cdot}333$ „
„ 4 „ „ - $\frac{D}{d + 4h} = \frac{500}{30 + 40} = 7{\cdot}142$ „
„ 5 „ „ - $\frac{D}{d + 5h} = \frac{500}{30 + 50} = 6{\cdot}250$ „
„ 6 „ „ - $\frac{D}{d + 6h} = \frac{500}{30 + 60} = 5{\cdot}555$ „
„ 7 „ „ - $\frac{D}{d + 7h} = \frac{500}{30 + 70} = 5{\cdot}000$ „

(2.) The second step is to find the cubic capacity of one row of blocks.

Let d = depth of one block;
h = height of one storey;
n = number of storeys;
L = length of area;

then d × nh × (L−nh) = cubic capacity of one row of blocks.

		cub. ft.
If 1 storey high -	$d \times h \times (L - h) = 30 \times 10 \times (250 - 10) =$	72,000
„ 2 storeys „ -	$d \times 2h \times (L - 2h) = 30 \times 20 \times (250 - 20) =$	138,000
„ 3 „ „ -	$d \times 3h \times (L - 3h) = 30 \times 30 \times (250 - 30) =$	198,000
„ 4 „ „ -	$d \times 4h \times (L - 4h) = 30 \times 40 \times (250 - 40) =$	252,000
„ 5 „ „ -	$d \times 5h \times (L - 5h) = 30 \times 50 \times (250 - 50) =$	300,000
„ 6 „ „ -	$d \times 6h \times (L - 6h) = 30 \times 60 \times (250 - 60) =$	342,000
„ 7 „ „ -	$d \times 7h \times (L - 7h) = 30 \times 70 \times (250 - 70) =$	378,000

(3.) The third step is to find the total cubic space enclosable.

Let N = number of rows of blocks;
C = cubic capacity of one row of blocks;

then N × C = total cubic space enclosable on the area.

If 1 storey high	-	12·500	×	72,000	=	900,000 cubic feet.
„ 2 storeys „	-	10·000	×	138,000	=	1,380,000 „
„ 3 „ „	-	8·333	×	198,000	=	1,650,000 „
„ 4 „ „	-	7·142	×	252,000	=	1,800,000 „
„ 5 „ „	-	6·250	×	300,000	=	1,875,000 „
„ 6 „ „	-	5·555	×	342,000	=	1,900,000 „
„ 7 „ „	-	5·000	×	378,000	=	1,890,000 „

On this area 500 feet by 250 feet, equal to 2·8787 acres, the amount of cubic space enclosable per acre, would be—

1 storey high	-	312,641 cubic feet.			
2 storeys „	-	479,383	„	- 53·3	Increase per cent.
3 „ „	-	573,175	„	- 19·5	
4 „ „	-	625,282	„	- 9·1	
5 „ „	-	651,335	„	- 4·1	
6 „ „	-	660,020	„	- 1·3	
7 „ „	-	656,546	„	- 0·5	

On the above area buildings four storeys high would enclose double the amount of cubic space of buildings one storey high under the same conditions.

On a larger area the increase of cubic space would be proportionately greater. For instance, if the area were double the depth and length (11·4784 acres), then under the same conditions the following would approximately be the amount of cubic space enclosable per acre :—

1 storey high	-	320,220		
2 storeys high	-	501,950	= 56·7	Increase per cent.
3 „	-	614,300	= 22·3	
4 „	-	687,000	= 11·8	
5 „	-	736,000	= 7·1	
6 „	-	766,650	= 4·1	
7 „	-	786,800	= 2·6	
8 „	-	798,450	= 1·4	
9 „	-	803,800	= 0·6	

So that, given an area, the greatest amount of cubic space enclosable with due regard to health provisions may be calculated, and the cubic space adopted as a uniform standard more valuable than the mere number of tenements, or of rooms, or the square space, as a basis of calculation for the size of block buildings, cost, accommodation, density, and mortality. And in proportion to the cubic space enclosable the number of persons housable on an area may be calculated.

Restriction of time will only allow of a brief but sufficient reply to the prevalent objections to blocks.

It has been urged that block dwellings are, from their unsightliness, repellent to the classes sought to be attracted; but it is a poor compliment to the resources of architects to attribute to them inability to provide embellishment at moderate cost by beauty of form, colour, and ornament. The objection that the working classes avoid them on account of their collective arrangement, and the objection that a class superior to those they are intended for takes possession of them, as well as the fact that residential flats are in favour may be left to the objectors

to reconcile with the construction of the dwellings and the habits of occupants.

It has been anticipated that blocks may rapidly deteriorate; but when substantially constructed, with due regard to sanitary and social requirements, their condition will depend upon efficient supervision and maintenance. Under proper management the one roof, drain, staircase, water-supply, gas service, &c., upon which so many are dependent is less likely to remain defective or unremedied than when under less direct supervision, and with fewer to complain, as in smaller buildings. Only improper usage can cause deterioration, and this applies equally to the small as to the large building.

The staircase open to the street is rightly regarded as a most objectionable feature. The staircases of tenement houses whose front doors are rarely closed are largely accountable for the defilement and destruction in this class of houses, and the same deterioration will ultimately doubtless take place in the blocks which replace them. It is necessary to distinguish between being open for the purpose of light and air, and being open to the access of any and everybody who chooses to enter. The former is as highly beneficial as the latter is detrimental. The staircases should open into the intervening space between the rows of blocks, but there should be only one public or main entrance to the courtyard or garden of block dwellings, and this should be directly under the control of the superintendent. The legislature is largely responsible for these open staircases, by the unreasonable manner in which the inhabited house duty is assessed, which compels the staircase to be open and form part of the street in order to claim exemption for the dwellings under 20*l.* a year (7*s.* $8\frac{3}{10}$*d.* per week) rental. This is a condition that urgently requires alteration.*

Apart from the influences of town life, is there any reason to suppose that block dwellings are *per se* unhealthy? Residential flats are not held to be less healthy than self-contained houses. Provided that the proportion of open to covered space is adequate to permit of proper access of sunshine and daylight, of sufficient aëration and perflation, increased height of building can scarcely cause any direct injury to health. On the other hand, the conditions of life are dissimilar in cottages and in blocks in important respects.

In block dwellings the families, and especially the children, are brought into closer and more frequent contact, and the sanitary arrangements are under more constant supervision. The effects of these conditions upon the mortality, as compared with London generally, have been most ably demonstrated in a paper upon the vital statistics of block dwellings read before the Royal Statistical Society in February of this year by Dr. Newsholme. He showed that, notwithstanding that the age-distribution of population in Peabody buildings was much less favourable to a low mortality than in London as a whole, the death rate was 2 per 1,000 lower, and that the birth-rate was much higher,

* The Customs and Inland Revenue Act, 1891, which has only just become law, indirectly removes the obstruction hitherto existing to the construction of block dwellings with one main entrance under the superintendent's control.

and the infantile mortality much lower than in all London. But that the death-rate of children between one and five years of age was higher, and was caused by scarlet fever, diphtheria, and still more largely by whooping cough and measles, diseases to which children are so prone, and which are communicated mainly by direct infection. In this respect the social condition induced by block dwellings resembles schools, and is equally remediable. Another point elucidated was the influence exerted by the greater supervision of sanitary arrangements, in the fact that the death-rate from typhoid or enteric fever was one-half that for all London, and it is well recognised that this disease is the best test of sanitary conditions available.

Time, again, will not permit of the consideration of the various classes of block dwellings, but the distinction between dwellings with private sanitary and domestic conveniences and those with conveniences in common is important, as it materially affects the social conditions, as well as the cost, and also the cubic dwelling-space available. The higher aim should be to construct blocks of "homes," the expression so aptly used by Mr. James Moore, the well-known secretary of the Improved Industrial Dwellings Company. This may be supplemented by baths and wash-houses supplied with hot and cold water and hot drying closets, a mortuary, means of isolation for minor infectious ailments, possibly a reading and a recreation room, or any addition that may make the workman's quarters in towns desirable residences according to the rental he can afford; and efficient regulations must be trusted to complete the work.

The high price of land impels private individuals and companies to erect block dwellings in great cities; but there is a limit to the size of these blocks, especially in height, as I have shown; with each storey of the building raised the economy of space increases in a correspondingly diminished proportion, so that the ratio of height of building to width of interspace being fixed, economy will self-impose a limit to the size of block dwellings.

The conditions of construction requisite to secure adequate light, air, space, and sanitation, in order to prevent injury to health may be defined. The maximum amount of cubic space encloseable on a given area in accordance with these conditions may be calculated. In proportion to the cubic space enclosable, the maximum population housable on a given area may also be calculated. But in the construction of block dwellings, the requisite conditions should not be permitted to be infringed, and to insure that these conditions will be observed, their construction should be controlled by special legislative enactment, imperial or local.

The reasons for demanding special legislation are various. All buildings, whether inhabited or not, are controlled by special legislation, but the requirements, and particularly those for open space, are totally inadequate for dwelling-houses of large size. Large blocks of dwellings, such as workhouses, prisons, asylums, barracks, &c., are erected under the responsible supervision of governmental or public authorities, which ensures due provision with regard to health being made; but no special

control is exercised to prevent irresponsible individuals from erecting a class of block dwellings inferior to the dwellings they displace. By special permissive enactment, the Government has provided in the Public Health Acts Amendment Act, 1890, that a building not originally constructed for dwelling purposes shall not be occupied as a dwelling unless it satisfy the requirements of the surveyor, but there is no definition of what these requirements are or should be. Factories are controlled by special legislation. Special legislation, again, has been created for the exemption of block dwellings from inhabited house duty, and upon medical officers of health the onus has been thrown of certifying that these buildings are constructed with proper provision for health, but there are no definitions of the conditions that entitle to this exemption. The Housing of the Working Classes Act, 1890, deals with houses unfit for human habitation, but there is a wide margin between the absolute unfitness of existing structures and the requirements necessary for future erections.

In order, therefore, to enable the special legislation already created in regard to existing block dwellings to be complied with, and also to prevent such dwellings from being erected in future in a manner prejudicial to the public health, special legislation to control the construction of block dwellings for the industrial classes in cities is indispensable.

Two and Three-Storeyed Tenements for the People.

BY

LOCKE WORTHINGTON, A.R.I.B.A.

The following remarks and figures are an effort to assist in showing the desirability and to prove the commercial possibility of constructing in our crowded centres of population isolated model homes for the weekly-wage-earning classes, in buildings of two and never more than three storeys in height, in accordance with certain arrangements of planning.

Although it may be well that philanthropy should be the motive in all schemes for the housing of the people in the metropolis or other centres of population, their execution should be based on a sound commercial foundation, and the rental of the buildings such as to secure a reasonable dividend. True philanthropy dictates the desirability of low tenement houses, and I have worked out two schemes to prove their commercial possibility.

The various commercial companies and other agencies which are employed in the metropolis in improving the dwellings of the weekly-wage-earning class have almost invariably erected blocks of tenements three, four, five, six, and even seven storeys in height, so arranged as to

crowd the greatest accommodation on the site, with often but little consideration for proper light and air, and constructed so as to save expense by the provision of common entrances, staircases, and conveniences. Many of these model blocks in London are excellently planned and built, while some are so arranged and constructed as to be no better than the condemned houses they replace.

It is not the province of this paper to enter into the merits and drawbacks of these existing metropolitan model blocks, which are being laid before the section by other members.

It would be well for the community if the 30 metropolitan agencies were to work more in the spirit of the following suggestions, which have already been tried, though not to any great extent, in the metropolis:—(1.) To buy up and put in order the existing dilapidated cottage tenements to be found in almost all localities of the metropolis. (2.) To construct in the suburbs, off the regular line of street traffic, two-storeyed houses at a rental within the reach of the classes earning low weekly wages. (3.) To erect in the metropolis new model tenements, never more than three storeys high, and, in so far as possible, private isolated homes.

With regard to No. 1, viz., the improvement of existing small houses:—If well carried out and superintended, Miss Octavia Hill's plan of purchasing houses, purifying them, and fitting them for habitation, is excellent and beneficial in all ways. With rentals varying from 2*s.* to 10*s.*, the cost of accommodation per family has been 118*l.* to 130*l.*, and the undertaking pays an average of 4 to 5 per cent. On the other hand, the cost of accommodation for families in such model blocks as are to be found in Farringdon Street, for instance, varies from 171*l.* to 315*l.*

With regard to No. 2, viz., the construction of suburban dwellings:—There is an estate in South Bermondsey which provides the following luxurious and private homes for 6*s.* 6*d.* The houses are built for two families, each tenant being responsible only for his own tenement, which consists of a parlour, bedroom, kitchen with the best kind of kitchener, and scullery with fireplaces, copper, sink, &c. With the exception that one tenement is above and the other on the ground floor there is no difference between upstairs and downstairs, and the homes on the first floor are so planned that the upstairs occupiers can, if they wish, keep themselves entirely private. On a similar principle, but with less luxury, suburban houses should and could be built at a rental of 3*s.* to 4*s.* 6*d.* Such homes are undoubtedly the most popular if the workman can arrange to live in the locality.

In support of No. 3, viz., the construction of cottage homes in the town, let me say that the existing model blocks often do not let well in localities where small houses enter into competition, even where the dilapidated condition of such houses may be both injurious and uncomfortable. Tenants prefer an uncomfortable cottage to a tenement in a large block of dwellings.

I have taken some pains to interview the superintendents and tenants of many model blocks in the metropolitan area, and also the

tenants in many of the dilapidated houses of our side streets, and almost invariably they state that they have a deeply-rooted dislike to living on the same staircase as 20 other families, who may or may not be respectable, and consider moving into "the buildings" as only a step better than going into "the house."

Estimate proving the commercial possibility of isolated houses in parts of the metropolis being buildings constructed only two stories in height.

CAPITAL ACCOUNT.

	£	s.	d.
Contractor's tender for building 200 cottage homes complete, according to drawings, specifications, and quantities -	29,000	0	0
Add for unforeseen extras and fees -	2,500	0	0
Total building capital required -	£31,500	0	0

ANNUAL EXPENDITURE.

Annual rental of land at 2½*d.* per sup. foot per annum - - - - -	646	10	0
Maintenance, on precedent of properties in the neighbourhood of Whitechapel, including rates, taxes, repairs, collection, management, empties, arrears of rent, &c. - - - - - -	951	0	0
Sinking fund - - - - -	40	0	0
Total maximum annual expenditure	£1,637	10	0
Total income from rents - -	2,795	0	0
Total expenditure - - -	1,637	10	0
	£1,157	10	0

This return of nearly 4 per cent. would become a safe 4½ to 5 per cent. if the tenements were three instead of two storeys high. The rents average 2*s.* 6*d.* a room, the majority being two-room tenements. The homes are isolated, and the accommodation is liberal.

The above figures are based on competitive tenders procured from contractors in the spring of 1890 on definite sites, in order to verify the statements made in the author's pamphlet "The Housing of the "Poor in London," April 1890, which was a plea for 'Cottage Homes ' in the Metropolis.'

DISCUSSION.

Mr. E. Bond, M.A., Hampstead, speaking on the question of flat roofs, said that people would not use them. They were difficult to keep dry, and expensive in plumbing. Architects had put up a number of buildings with flat roofs, but somehow they did not take. With regard to the cottage-dwellings advocated by Mr. Rowland Plumbe, he was glad to hear so pleasing an account of the experiment at Noel Park, but he regretted the mention made of Miss Octavia Hill, because the latter did not go so far as Mr. Plumbe, although that lady had undoubtedly a *penchant* for cottage-dwellings. He knew a lady who had lived for a considerable period in a block of dwellings, and who spoke of them very highly. He was of opinion that when such dwellings were properly looked after, the objections commonly brought against them would be found to have no good foundation, but the lady admitted that the system would break down if anybody who chose to pay the rents demanded were admitted. A proper superintendent and proper regulations were necessary, and the regulations must be enforced strictly, as in city residences they always were. He was not an advocate for surrounding London with groups of houses such as Noel Park. London might be considered a huge wheel, of which the lines of communication were the spokes. Noel Park was on one of the great lines of communication, and if such groups continued to be multiplied they would soon have crowded agglomerations in certain spots with great open spaces intervening. London was made up of a number of once separated villages, now in process of time connected. The cottage-dwelling, which had usually one story above the ground-floor, was the commonest type of London house, and if, as had been stated, there were only 200,000 persons dwelling in the blocks, they were not likely just yet to oust the cottage-dwellers. With regard to block dwellings, he did not think there was much in the noise or in the height objection. A more formidable objection was the want of proper spacing. If the sites were of sufficient area for the number of blocks to be erected, the ground-floors ought to be as light as the upper floors. There was an enormous difference in the price of sites in different parts of the metropolis. He knew of sites where the price of the land would reduce the ground-rent per room to 3*d.*, 3¾*d.*, or 4*d.*, while other quite similar sites, bought in the ordinary market, would cost 7*d.* per room.

Mr. Noble Smith, F.R.C.S. Edin., said that the last speaker declared that the flat roof had been tried as an experiment, and had failed. That might be only because it had not been sufficiently tried. They could not hope to influence much the formed habits of the adult; it was the young whose habits they might be able to reform. A most prolific cause of disease and death among children was due to rickets. It had always been found that as opportunities of getting exercise in fresh air increased, the tendency to rickets diminished, and that disease alone was the cause of so large a proportion of all ailments that it was worth a great effort to reduce it. Nine-tenths of the cases of accidents treated in hospitals were accidents occurring in the streets—children run over or knocked down by vehicles. The effluvium of the streets was injurious, and rendered them very undesirable places for recreation.

Mr. Ralph Nevill, F.S.A., pointed out that much of the unhealthiness of back streets had passed away through the introduction of asphalte. All back streets and courts should be asphalted. The whole life of people living in courts had been changed by asphalte. Concrete

might be successfully employed for flat roofs, but nothing was so likely to be permanent as asphalte. The principal objection he had to urge against flat roofs was that there was no society there. The cottages that surrounded our village greens in England were among the great beauties of English landscape. Block dwellings were not attractive to country people, and such people would not go on roofs. With regard to spacing, he agreed with Dr. Sykes, and pointed out how the latter's arguments might be strengthened.

Mr. J. P. Seddon, F.R.I.B.A., said that London was no place for factories, and some day when we had stifled an archbishop, we should find that out. London would be greatly improved if through the squares, which at present seemed to be given up to cats, they were to drive wide boulevards.

Mr. S. M. Burroughs pointed out that in New York City the upper floors were more sought after, and obtained higher rents, than the first and ground floors. A higher value was placed upon the flats the higher you went up. The houses were higher, and had a larger number of floors than those known to our builders. The high price of land was the cause. It was the public that had given the high value to the land, and yet the public were not allowed to have any share in the profits. On the contrary, it had to pay more and more as the increment grew, to persons who had not earned it.

Mr. Hooper (Director of the Victoria Dwellings Company) referred to the paper on "Block Dwellings," and to the objections commonly urged against them. One of the best-founded objections was the great height of the buildings. They caused draughts of cold air in the streets below, and shut off from them the rays of the sun. It would be an improvement to increase the size of the windows. He had had some experience of the use of flat roofs as playgrounds. It was not of a favourable character. The tenants at the top were inconvenienced by the noise, and gave notice to quit. The Company had been obliged to forbid the use of the roofs for playgrounds. It was very difficult to keep such roofs water-tight. The erection of blocks of dwellings, in places till then occupied by small houses, had often been found beneficial to a district. One such district, which had always been a terror to the police, on being cleared and the site occupied by blocks of dwellings, had been rendered quiet and tranquil.

Mr. H. L. Beckwith (Liverpool) wished to mention some of his Liverpool experiences of blocks of dwellings in the Scotland-road district. Large numbers of people of the lower class had been cleared out of small old houses and sent into blocks, but it was found that they would never buy coals as long as the doors and windows were intact. If Dr. Sykes could suggest a remedy for that, they would be greatly obliged to him.

Mr. Councillor Hannam (Leeds) agreed that it was very difficult to make flat roofs watertight, and he regarded them as things of the past. With regard to small houses, he said they had in Leeds a large number of back-to-back houses. They admitted that such houses were bad in principle. They could forbid them, but to do so would be as useless as to forbid the putting up of walls anywhere round about Leeds. The Council must pass the plans sent in, if they fulfilled certain conditions. They had 50 blocks of dwellings, each of eight buildings in a block. He was glad to welcome the remark that the width of the street should be in proportion to the height of the houses.

Mr. H. H. Collins said he did not wish it to go forth that the section approved of building back-to-back houses, which stood condemned by the whole world. As to block dwellings, a great objection to their use was exactly what Mr. Bond had said, though with different intent. Mr. Bond had pointed out that it was requisite to carefully select the tenants, as, otherwise, they would get undesirable ones, and that a superintendent was wanted to see that the regulations were complied with. That seemed to him to be the description of a prison rather than a home, and that was just why costermongers and similar classes of people preferred to live in their insanitary dwellings to going into the sanitary but inquisitorial ones. With regard to the philanthropists who formed companies with a large amount of money, and paid dividends of 4½ and 5 per cent., they could make conditions with county councils, and get land at a far different price to that which the ordinary builder had to pay The consequence was that there was no healthy competition between private and public enterprise. Frequently he had advised friends to acquire some plot that was admirably adapted for artisans' dwellings, but the answer had been that they could not afford to let the rooms under 3*s.* 6*d.* a week. If they went to the Peabody Buildings, they would find that the rooms (built with charitable funds) did not cost more than 1*s.* 10½*d.* to 2*s.* There was no use in investing money under these conditions, for, even if the rooms were let, tenants were certain to move as soon as there was a vacancy in Peabody Buildings. It was antagonistic to private enterprise to compete with public or semi-public funds. Sir Sydney Waterlow made it a boast that they could make more than 5 per cent., but they only gave shareholders 5 per cent., and no more. It seemed to him time to turn the tide in favour of these companies being placed in the hands of the trustees. As to the character of the tenants, it so happened that there was a block of buildings at Canonbury almost identical with the plan of Dr. Sykes, which had been intended for the artisan class. the outside rent being 2*s.* 6*d.* per room. But all these buildings were *not* occupied by the class for which they had been intended. There were no inquisitorial conditions. All they wanted were people who were respectable and paid the rent. There was the usual inspection every six months to see that the repairs were attended to. To his astonishment, he heard music going on in these buildings, and he found them to be occupied by clerks, and so forth. Referring to working men's houses in suburbs, arrangements should be made with the railway companies to enable the occupiers to recoup themselves for the time and money required by travelling.

Dr. Grimshaw, Registrar-General for Ireland, said that comparison of the experiences of various towns was of the greatest importance, and he would give them his experience with regard to Dublin. Most of what he had so far heard related to London, where altogether different circumstances prevailed, the area between the city and the suburbs of Dublin being perhaps one-twelfth that of London. His remarks might also be of interest to the other towns represented. In the first place, the artisan must live near his work, not necessarily in distance, but in point of time. The cost of covering a great distance was counterbalanced by a heavy rent in town, and the expense was, therefore, the same thing. For the artisan's health, however, it was better to live out of town. The Dublin Artisans' Dwellings Company had been founded some 17 years ago, with a view to carrying out the Act which had just then been passed. They had commenced with a capital of 50,000*l.*, which had been gradually raised by subscriptions and loans to 200,000*l.* They had tried both block

buildings and cottages, the result being that the cottages had been much preferred, and they also paid better, for two reasons. The first reason was greater economy in construction; and, in the second place, it had been found that the tenants deserted the blocks for cottages if any cottages were built within a reasonable distance of blocks. People were quite willing to pay more rent for a cottage than for rooms in a block. The result in one portion of Dublin was that the company actually had to reduce the rent of blocks in order to enable them to compete with their own cottages erected in the vicinity. The company paid a dividend of 4½ per cent., and had a considerable depreciation fund. He wished to mention these points specially, as there seemed to be some sort of controversy as to which was the best form of house for the artisan. Dublin artisans undoubtedly preferred the cottage, in which they took more interest than in blocks, and which they liked to make homely by little decorations. He might mention that the reason why he was so intimately acquainted with the interior and the little artistic efforts was that for some years a prize was offered for the best kept house. Anyone who chose to put his name down for these prizes was enrolled, and he had undertaken to act as chairman and organiser to go round these places and examine them, the result being that the cottagers invariably beat the inhabitants of the block habitations for tidiness, neatness, artistic arrangements, and for window gardens and flowers. Therefore, he was one of those who believed in the moral influence of things of that sort, and, morally he thought cottages were a superior method of housing the working classes to block dwellings. He would mention that the death-rate in these houses was singularly low as compared with that of the whole of Dublin, but Dublin was unfortunately, a town with a very considerable death-rate. The width of streets was a matter which came only slightly into question in Dublin, because it was not the habit there to build very high houses, owing to the fact that ground rents were not as dear as in London. However, as a medical man, he looked upon the width of streets as one of the most important elements in the matter of health. It was not merely a question of air-space that was involved, but also a question of light. Human beings were as much dependent upon light for their health as plants, and would come into a half-starving condition without sufficient light and air-space as the latter. The question appeared to be whether the housing of the working classes was to be carried on as philanthropy, as business, or as a mixture of both. His opinion was that enlightened business companies who had regard for fair dealing with their tenants possessed quite sufficient philanthropy, and yet worked on sound business principles, and he considered that the plan adopted by the Corporation of the City of Dublin in dealing with the problem was founded on the best principles. The Dublin Corporation provided nightly lodgings, single rooms, and dwellings for very poor people, either single or married without children. They had also supplied small cottages at very low rents, limiting these according to the circumstances of those who occupied them, on the principle that this part of their work was, in fact, in the nature of philanthropic efforts to assist these people.

Mr. Councillor Atha, Leeds, said he had understood, two days previously, that the question of back-to-back houses or cottage dwellings *versus* flats or blocks was to have been adjourned to the present sitting. He did not know what his friends might think of him if he stated that he lived in a district populated by 75,000 people, and that 75 per cent. of the houses were back-to-back ones. But he wished gentlemen to understand that

there were back-to-back houses and back-to-back houses, and those constructed in Leeds must not be compared with the old-fashioned ones,—badly spaced, with dirty corners, &c. They were constructed on sound principles, with good sanitary arrangements for cleanliness, the prevention of dirty corners, &c., and the death-rate of his district had been almost the lowest of the borough when the last figures were taken. It was 18 and a fraction, whilst in other districts it was over 22. Mr. Atha, assisted by an illustration on the black-board by the Chief Inspector of the Leeds Corporation, explained that there were blocks of sixteen houses arranged in two rows of eight each, and separated in the middle by a space of 15 ft. wide. That space contained the closets for the sixteen houses. The streets running round the blocks were 36 ft. wide, and were well looked after. He was very much startled to hear anybody advocate erecting great buildings for the working classes in London, because there was a danger in throwing too many human beings together. Their system of back-to-back houses distributed the population over a large surface, and if properly built, the whole of the blocks could be kept as dry and well ventilated and as healthy as any other houses. If they forced upon the working population houses at higher rents, they would pay as long as they were in good employment, but with lack of work setting in they could not pay. Their principle of giving the men cottages, even if built back-to-back, made them saving and thrifty, because they felt they had homes in their cottages. There were hundreds and thousands in Leeds who strained every nerve to purchase the freehold of their own cottages. Under other systems all the individuality would be driven out of them.

In answer to various questions by the **Chairman,** the Chief Inspector of Leeds said that every house was self-contained, except the conveniences There were two bedrooms, two sitting-rooms, kitchen, scullery, and a spare room. Every room had a window.

Mr. Gordon Smith said he was very anxious that the gentlemen from Leeds should not go back to Leeds under the impression that back-to-back houses were at all admissible. He thought that question had been quite settled, and he was prepared to show that there were no advantages and a great many disadvantages, in back-to-back dwellings. As regarded cost, there was practically no difference, as no more than the requisite conditions were insisted upon. As regarded the difficulties they had to deal with at Leeds, he knew that they were acting under an Act of Parliament, but that could be altered very easily if there were a desire to that effect. That had been done in Liverpool, Manchester, Birmingham, and other important towns.

The Chairman (Mr. Blashill) held that every kind of view had now been well discussed, and he would now use his privilege of making some observations. It was quite true that a large percentage of the population in any kind of town was desirous of rising and of improving their homes, and, as a general rule, did very considerably rise. But, unfortunately, there was also a number whose tendency was exactly in the opposite direction, whatever kind of accommodation was offered to them, and with them there was the trouble. There were good, bad, and indifferent everywhere; but the young wanted teaching, and, therefore, the principles advocated by those in power must be the very best from every point of view. Every class of habitation wanted supervision as far as it was found necessary. If it were shown that the higher classes neglected their habitations, they would also have to be supervised. He could not agree with

those who spoke so strongly about the impossibility of supervising the erection of houses. If they gave the local authorities sufficient power, they would exercise it with care and tenderness. The officer appointed was too often in the painful position of being obliged to pass building which he would have wished not to pass. In his opinion the authorities of great and important communities should have the power of fixing the lowest scale of accommodation, an irreducible minimum, in which any of their members should live. That might seem a radical proposition, but sooner or later it would have to come to that, even for "unskilled" labourers. He did not know what "unskilled" labour meant, unless it referred to people who could not do anything. He knew of no labour that did not require some skill, and they were not going to erect wretched buildings simply because a certain small class of the population did nothing, and could not work, and called themselves "unskilled labourers." As to the kind of houses in which people should live, there was a diversity of taste as of means. Some people liked to live in a block, or let them call it "residential flats": it might suit them; others might prefer a house. It was simply a question of £ *s. d.* It had been said that land was dear, but then wages were high. There was no place in Europe, he ventured to say, where so much food and clothing and other commodities could be got for so little money as in London. What they had to do was to increase the wage-earning power of the individual, and not to encourage him to say that he was ignorant and therefore compelled to live poorly. More money must be got, not the accommodation minimised. As to height of buildings, the rule in the London County Council now was not to let buildings go higher than four stories, and the Council had now land to dispose of for such buildings. One gentleman had spoken about taking away factories from towns; but towns were not meant primarily for residences, and secondarily for factories; but, in the first place, for work, and in the second place, for residences. He would not live in London, nor in any town, if he had not work to do there, and therefore the idea of doing away with the factories was fallacious. They must make the dwellings healthy, and the factories wholesome places to work in. They had heard what the gentlemen from Leeds had to say about back-to-back houses. He regretted exceedingly to have heard such a story. The feeling in that room was one of distinct disapproval, and he hoped that they would take this lesson back to Leeds with them. From what he had gathered, Leeds had not adopted the Public Health Act in those points which dealt with back-to-back houses. If 75 per cent. of the people of Leeds lived in such houses, and had to put up with all these unhealthy arrangements, it was a lamentable state of affairs, and he thought it was not the kind of thing that would commend itself to the section.

Mr. Rowland Plumbe said he was rather anxious to state that he did not for one moment wish to say that block buildings could be done away with. Mr. Bond seemed to think that his opinion was entirely in favour of village homes, which, however, he knew to be an impossible plan. He would say, however, that the more we got our working-classes into fresh air, and to live in homes of their own, the better it was for us and for them. He would like to call attention to the necessity for legislation in order that third-class passengers might be treated on the same footing as first and second-class passengers. Cheap trains up to half-past five in the morning and, perhaps, double the fare two hours later, were of very little use to the majority of workers. If pressure could be brought

to bear upon the railway companies to give cheap fares to third-class passengers, a great problem would be solved as to housing the working classes in village homes.

Dr. Sykes said that the requisite conditions for light, air-space, and everything else could be observed in block dwellings, as in other classes of dwellings. But there was no legislation for the control of the construction of this class of dwellings, although they required particular control. They might build the largest building nine stories high, with 300 sq. ft. of open space, which was monstrous. That was done in the metropolis, and they would admit that this was a serious question, and that something must be done. He moved the following *Resolution*:—

> "That special legislation is requisite for the control of the construction of block dwellings for the industrial classes in cities."

This was seconded by Mr. Plumbe, supported by Dr. Wilberforce Smith, and agreed to.

Friday, 14th August, 1891.

The President, Sir Arthur Blomfield, in the Chair.

English Isolation Hospitals.

BY

Dr. R. Thorne Thorne, M.B., F.R.S., F.R.C.P.

The statutory methods adopted in England and Wales for the promotion of public health may, for administrative purposes, be divided into two classes:—1st, those which are purely permissive, their adoption being left to the discretion of the local sanitary authorities; and 2nd, those which the Central Government have the power of enforcing in cases of default. The former constitute numerically the main bulk of the sanitary measures adopted in this country, and to this class belongs the provision of hospitals for the isolation of cases of infectious diseases, the statutory enactment as to which is to the effect that:—"Any local authority *may* provide for the use of the inhabitants of "their district hospitals . . . . for the reception of the sick." —Public Health Act, 1875, section 131. But notwithstanding the voluntary character of the action taken under this section, and the fact that the total cost of procuring and maintaining any such institution has to be entirely borne by the local community for whom it is provided, noteworthy progress has been made in this direction, and the isolation in sanitary hospitals of such cases of infectious fever as cannot properly be isolated in their own dwellings now forms an important and an increasing element in the protection of the public against the spread of "dangerous infectious disorders."

In a report which I presented to the Local Government Board some nine years since, on "The Use and Influence of Hospitals for Infec-" tious Diseases," * I stated that out of about 1,510 provincial sanitary authorities in England and Wales in 1879, 296 possessed some means for the isolation of the infectious fevers, other than that intended for poor-law purposes; and I find that, since that date, loans, amounting in all to 448,769*l.*, have been granted to over a hundred sanitary authorities for the provision of isolation hospitals. Some of these loans, it is true, relate to the replacement of former hospitals by more efficient ones, and to the extension of existing ones; but, on the other hand, a number of isolation hospitals have been erected out of current rates and otherwise than by the aid of loans, and I am probably correct in stating that some adequate means for the isolation of infectious diseases are now possessed by at least 400 urban, rural, and port sanitary authorities; and, it may be added, that there is already evidence that the adoption by a large number of sanitary authorities of the permissive clauses of the Infectious Disease (Notification) Act, 1889—a measure by means of which early and precise information is secured as to the extent to which infectious diseases prevail in any district—is likely to lead to a substantial increase in the number of English isolation hospitals.

Diseases calling for isolation.—The infectious diseases which, in this country, especially call for isolation in hospital are, in the order of their importance, as follows:—Scarlet fever, typhus, small-pox, diphtheria, enteric fever, and cholera; and to these may be added, as being less frequently isolated in hospital, erysipelas, measles, whooping-cough, and puerperal fever. So far, there is no evidence that aggregation of the infectious sick suffering from any of these diseases, except small-pox, such as is likely to be carried out by any ordinary sanitary authority, leads to diffusion of infection to the surrounding community, provided the hospital be properly constructed and administered, and subject to a zone of some 40 feet being provided between all buildings intended to receive infected persons or things and the boundary wall, or close fence, around the site. Experience has shown that it is otherwise with small-pox; and it yet remains to be ascertained what are the circumstances under which cases of that disease can be aggregated for the purposes of sanitary authorities, without risk to the community. Fortunately, owing to the protection afforded by vaccination, small-pox does not, as is commonly supposed, stand foremost amongst the infectious fevers calling for isolation in hospital. As a rule, port sanitary authorities alone make special provision for cholera.

The following are some of the principal points to be kept in view in providing for the other dangerous infectious disorders which have been referred to.

Extent of provision to be made.—Speaking generally, it has been estimated that the provision of one bed per 1,000 inhabitants, is

* Supplement by the Medical Officer to the Tenth Annual Report of the Local Government Board [C. 3290] 1882.—Re-issued 1884.

sufficient for the permanent requirements of a sanitary district. But such requirements will necessarily vary in accordance with the character of the population. Thus, in a locality where the population is well-to-do and most houses are of a size and construction that offer reasonable facilities for the isolation of single attacks of the current infectious fevers, the amount of hospital accommodation needed for public health purposes will be less than in a manufacturing or colliery district, where infectious disease cannot be treated in the houses in which it breaks out without very great, if not certain, risk of spread. As yet, no sufficient experience is available as to the effect of the compulsory notification of infectious diseases on the amount of accommodation which should be maintained for isolation purposes. It may reasonably be expected that in time such a measure will so far prevent the diffusion of infection as to reduce the amount of standing hospital accommodation necessary for the isolation of the infectious fevers. But, as yet, from the experience of some sanitary authorities, and especially as regards such a disease as scarlet fever, the new sources of information of which authorities become possessed have led to an increase in the number of persons removed to hospital, and thus to a need for additional means of isolation.

Character of accommodation required.

Premising that all the conditions which are deemed essential in the provision of a healthy dwelling-house are to be regarded as equally desirable in the case of an infectious hospital, I would only here refer to such other points as involve considerations peculiar to such hospitals.

(a.) *As regards site.*—It is, as a rule, undesirable to select any site which is less than some two acres in extent; and even then regard should be had to the need for extension of hospital buildings, whether for temporary purposes or owing to increase of population. Where practicable, only single-storey hospital pavilions should be contemplated; and having regard to their distribution on the site, and to the out-door exercise of convalescents, 20 patients per acre will generally be found to be the limit of aggregation of sick on area.

(b.) *As regards buildings.*—The administrative building should be distinct from all others. Nurses, when off duty, will live and sleep in it; tradesmen will call there for orders and with supplies; and relations will there make inquiry as to the progress of the sick. This building should always be so placed as to control all access, from without, to the ward-pavilions and other hospital buildings. The laundry, ambulance-shed, disinfecting apparatus, and mortuary should also be in one or more buildings separate from the administrative building and the ward-pavilions.

No sanitary district can be regarded as properly provided for unless it has immediately available sufficient accommodation for the isolation of two different infectious diseases in both sexes, and some means for the special isolation of one or two patients needing separate accommodation, as, for example, cases in which the nature of the disease is, at first, doubtful. These requirements are usually met by the provision of two

pairs of wards or rooms having no aërial communication with each other, together with one or two special isolation rooms. In sparsely populated districts these requirements may be combined in one pavilion the several apartments of which open separately onto verandahs. Such a building is commonly styled an isolation-pavilion.

Each ward-pavilion should admit of cross-ventilation by means of windows in the two opposite side walls; the closets and ward sinks, having themselves independent means of cross-ventilation, should be entered from the wards by means of a cross-ventilated lobby; all angles, vertical and horizontal, should be rounded to prevent deposit of dust, &c.; and a nurses' duty-room should be provided. Assuming that each ward will contain the ordinary proportion of acute and convalescent patients, and that it is adequately ventilated and warmed, a minimum of 2,000 cubic feet of air per head is generally found to suffice in order to maintain reasonable purity of air. But much depends on the allotment of this amount of air to the individual patient. No excess in the amount of total air provided—as, for example, in the case of lofty wards—can compensate for crowding patients on the floor-level; and hence the beds should be so arranged as to ensure for each patient a floor-space of some 156 square feet. And since it is in the neighbourhood of the patients, mouth and nostrils that it is above all important to maintain the purity of ward-air, it is of all things necessary to allot to each bed a separate amount of wall-space, not less than some 12 feet in length.

(c) *As to allotment of bed-space.*—The best position for the beds is that one bed should occupy each wall-space between a pair of windows, the head of the bed to be at least one foot away from the wall, so as to facilitate movement of air about the patient's head.

Medical advice is often sought as to the number of beds that should be placed in any one ward of an infectious hospital. In suggesting an answer to this question, I cannot avoid the conclusion that the practice of treating sick persons under circumstances which admit of the air by which they are surrounded being charged, more or less, by the emanations of other sick persons is wrong in principle, and that from this point of view any aggregation of the sick in wards is undesirable. But other considerations must, in the case of a large proportion of the population, be regarded as outweighing this one; and all that can properly be contended for is, that the limit of such aggregation shall be decided by considerations such as are involved in securing freedom from any recognisable risk, together with such efficiency in general administration and nursing as is consistent with a reasonable regard for economy.

The several infectious fevers, doubtless, differ in regard to the amount of nursing which the sick require; but taking them as a group, and assuming that the ordinary proportion of acute and convalescing cases at varying ages are brought together, it may be held that any one nurse can rarely be expected to take charge of more than 12 patients. The moment this number is exceeded, the nursing staff has to be doubled; and directly a second nurse is required, it would be better in the interests of the sick, that those whom she nurses should

be in a separate ward. Holding this in view, I believe it will generally be found desirable that infectious hospitals should be built in pavilions so contrived that in each there shall be two wards, one for males and the other for females, containing together not more than 12 beds; the two six-bedded wards to be separated by nurses' duty-room and an entrance lobby.

The principles which have been laid down are embodied in the Memorandum as to Isolation Hospitals, issued by the Medical Officer of the Local Government Board; and they are those which now govern the construction of nearly all modern isolation hospitals in England and Wales.

The Heathcote Hospital, Leamington.

BY

KEITH D. YOUNG, F.R.I.B.A.

This hospital was erected in 1889 by the Warwick Joint Hospital Board, the constituent authorities of district being the urban districts of Leamington Spa, Warwick, Kenilworth, Lillington, and Milverton, and the rural sanitary district of Warwick Union. Since the formation of the joint district the districts of Lillington and Milverton have been amalgamated with the borough of Leamington.

The site is six acres in extent, two and a half acres of which are enclosed and appropriated to the hospital use. It stands on the high ground in the middle of open fields, and is about midway between the towns of Warwick and Leamington.

The population within the joint district was, when the hospital was erected, about 55,000, and of this number some 44,000 were within a radius of three miles from the hospital site.

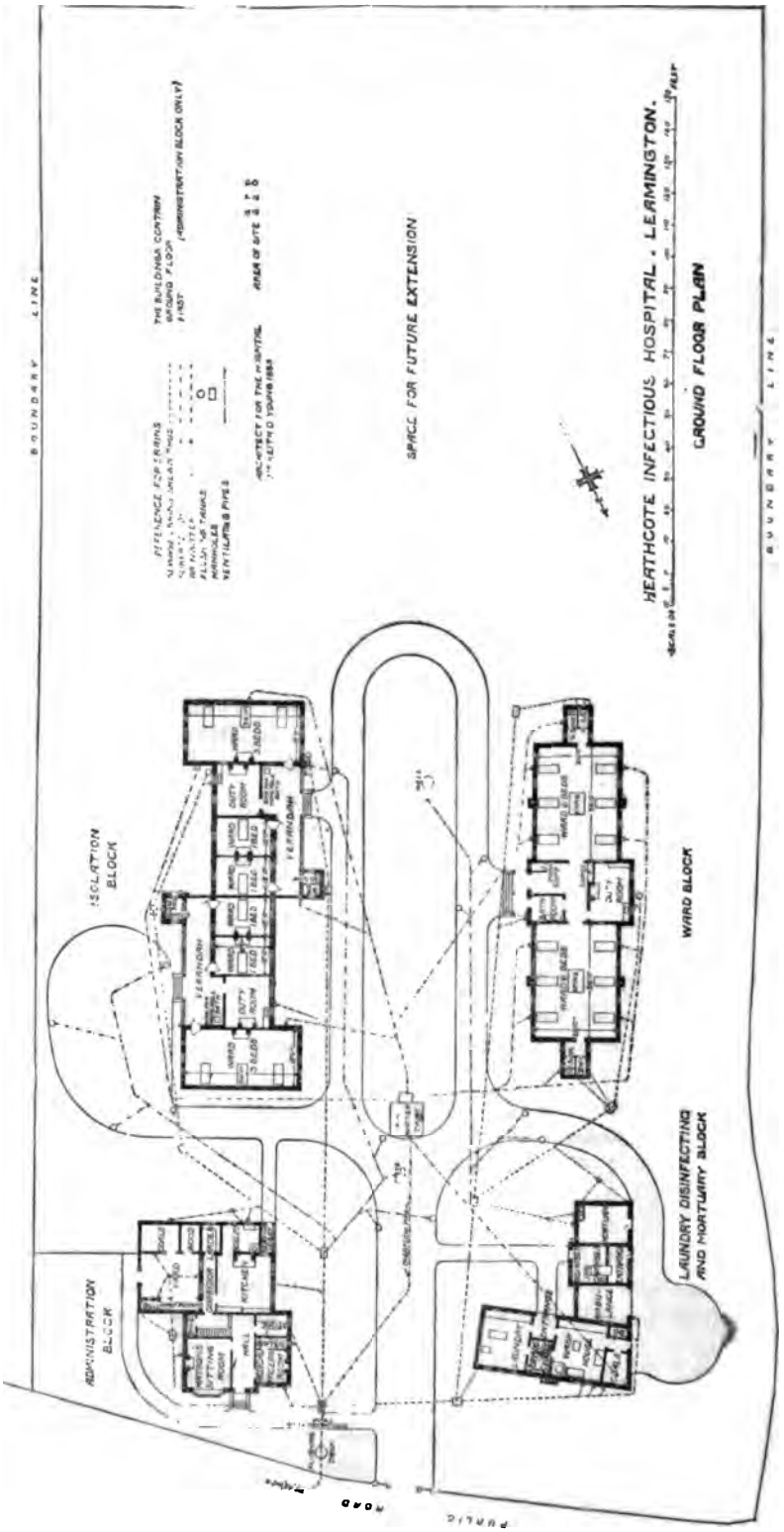
The area of the district is 44,507 acres, and its rateable value 340,000*l*. The accommodation provided is equal to one in every 2,000 of population.

The buildings are four in number, and each is entirely detached from the remainder. They are:—

1. The administration block;
2. The isolation block;
3. The ward block; and
4. The laundry block.

The site is enclosed on three sides by a high wooden fence; the front towards the high road having a dwarf wall and an iron railing.

The two blocks occupied by patients, and the laundry block, are each 40 feet distant from the boundary, and an inner fence at a distance of 40 feet from the front gates prevents patients from approaching too near the latter.


HEATHCOTE INFECTIOUS HOSPITAL, LEAMINGTON.
GROUND FLOOR PLAN
SPACE FOR FUTURE EXTENSION
ISOLATION BLOCK
ADMINISTRATION BLOCK
WARD BLOCK
LAUNDRY DISINFECTING AND MORTUARY BLOCK
BOUNDARY LINE
PUBLIC ROAD

The administration block is the only one of the four buildings two storeys in height, the rest being one storey only. It contains on the ground floor a sitting-room for the matron and nurses; a room, with a lavatory and w.c. attached, for medical officers; linen room, w.c. for nurses, kitchen, scullery, and larder, with wood and coal stores, and servants' w.c. in the yard. At one corner of the kitchen is a serving hatch opening into a covered porch at which the meals for the patients are given out.

On the upper floor are bedrooms for the matron, nurses, and servants, and a bath room.

The isolation block is divided into two equal parts by a wall, and the arrangements on one side of the wall are an exact counterpart of those on the other side, the entrance to one side being on the east, and that to the other side on the west.

Each half of the building, therefore, contains a large ward for three beds, two small wards for one bed each, a nurses' duty room, and a w.c. and slop sink. These rooms communicate with each other by way of an open verandah, roofed over at the top, but quite open in front.

Each large ward is 36 feet long by 18 feet wide, the smaller wards being 18 feet by 12 feet, and all are 12 feet high. The allowance of floor space is 216 feet per bed, and of cubic space 2,592 feet per bed. The large wards are lighted by three windows at each end, the smaller ones by one window on each side, being in the proportion of one square foot of window surface to about 65 feet of cubic space. The windows, which form the principal means of ventilation, are divided into two parts by a transom which is fixed about 1 foot 6 inches down from the head of the frame. Below the transom are ordinary double hung sashes provided with a deep bottom rail and a cill board which permits of the lower sash being raised and a current of air admitted in a vertical direction between the two sashes, at the same time preventing free access of air at the cill level. Above the transom is a "hopper light" hung on hinges at the bottom to fall inwards, and provided with glazed cheeks at the sides to prevent down draughts.

In addition to the windows, openings are made at the floor level behind each bed, and provided with Ellison's radiator ventilators; there is also an extraction flue in each ward carried up alongside the smoke flue from which it is separated by iron plates. The inlet to the flue is at the ceiling level, and a Bunsen burner is provided with a view to produce an upward current when the fire is lighted.

The wards are each provided with a Boyd's hygiastic ventilating grate; these grates have at the back of the fire an air chamber which is supplied with fresh air from the outside. The air being warmed by contact with the heated fire-brick back of the stove passes into the room through a grating above the fireplace.

The walls of the ward are lined to a height of 5 feet with tinted glazed bricks, above which they are plastered and distempered. The floors are laid with yellow deal in 3-inch widths, ploughed and tongued.

The vertical angles of the walls, the horizontal angles at the junction of floors and walls, and of walls and ceilings are all rounded, so also are all the angles of door panels and of the windows and in the finishing of the doors and windows rounded fillets only are used, no recessed mouldings being used anywhere.

The nurses' duty room is provided with a small range with oven and boiler, and hot water is laid on from the latter to the sink, the movable bath, in corridor, and the slop sink. There is also in this room a small dresser, and a glazed porcelain sink.

Outside the duty room is a recess, where the movable bath stands. A glazed fireclay sink let into the floor takes the waste, and taps fixed to the wall afford the supply of hot and cold water.

The water-closet and slop sink are placed in projecting buildings, entered from the verandah. The walls of these offices are lined with glazed bricks, and the floors are of cement. The slop sinks are of porcelain, provided with a flushing rim, in addition to the hot and cold water taps. The closets are Hellyer's pedestal hygienic, the trap and basin being made in one piece of porcelain, and are fitted with 3-gallon flushing cisterns, and hard wood rim seats hinged at the back.

Ward Block.—This building is entered from the centre, and affords accommodation for 12 patients, all of one disease, the beds being equally divided between the two sexes. In the open porch at the entrance are two doors; one of these gives access to the entrance lobby, the other being an outer door to the bath room. The object of the latter is to enable a patient on being discharged to leave the building directly from the bath room. The bath room thus becomes a discharging room; not perhaps an ideally perfect arrangement, but certainly a better one than if the patient had to re-enter the ward after his final bath.

To the left of the entrance is a smaller cupboard with a window for food, and opposite are cupboards for patients' clothes and linen. Between the wards is the nurses' duty room, in which is a small range with boiler for supplying hot water to the bath, sinks, and lavatory basins, a dresser, and a porcelain sink.

The wards are each of them 36 feet long and 26 feet wide, and contain six beds each. To each bed is allotted a floor space of 156 feet, and a cubic space of 2,028 feet, and the distance from centre to centre of each bed is 12 feet. The window area is in the proportion of about 1 foot of window to every 60 feet of cubic space. The means of ventilation are similar to those adopted in the isolation block. The grates also are similar, but in these wards are placed in pairs, back to back, in the centre of the floor, with descending flues carried under the floor to vertical chimneys in the outer wall. The latter are swept from the outside.

The water-closets and slop-sinks are placed in the projecting buildings at the end of the wards, from which they are separated by cross ventilated lobbies.

The construction of these wards as regards internal finlshing of floors and wall surfaces, &c., is in all respects similar to that of the isolation block.

A speaking-tube connects the duty room with the administration block.

The laundry consists of a wash-house fitted with the usual appliances for washing, an ironing room and a drying room heated by the flue of the ironing stove, and fitted with a radial drying horse. Adjoining is a w.c. and a coal store.

The disinfecting house is divided into two parts by a brick wall. The apparatus, which is one of Washington Lyon's high-pressure steam machines, projects on each side of this wall, so that the infected clothes are put in in one chamber and when disinfected are taken out by the door in the other chamber.

The mortuary is a plain sky-lighted room, arranged for use, when necessary, as a post-mortem room. The ambulance house affords accommodation for a one-horse ambulance.

Drainage and Water Supply.—The drainage system is a dual one, the rain-water being separated from the sewage and stored in a tank for use. The drains are all laid with glazed stoneware pipes jointed with cement, with manholes at each junction and change of direction. Each length of pipe between the manholes was separately tested with water before being covered up, and all the pipes are laid on and partly embedded in concrete. At the head of every length of drain is a Doulton's 30 gallon automatic flushing tank, and at the outfall to the public sewer is a large flushing tank fixed by the town authorities. These flushing tanks were specially necessary in this case, as not only is the quantity of sewage discharged at one time necessarily small, but the sewer conveying the hospital sewage to the town sewers has to traverse a long distance before it comes near any other buildings. The soil pipes are carried up above the eaves of roofs their full diameter as ventilating shaft.

The rain water from the roofs is all collected into an underground tank, first passing through a filter chamber formed partly of coarse and fine gravel, and partly of charcoal. From the tank it is pumped for use in the scullery of the administration block and the wash-house.

The cost of the hospital was as follows:—

	£	s.	d.
1. Land - - - -	900	0	0
2. Buildings, including laundry fittings, disinfecting apparatus, roads, paths, fences, drains, and professional charges	7,635	10	6
3. Gas mains, from nearest point up to site	84	4	4
4. Water mains - - - -	161	10	11
5. Sewer - - - -	299	4	9
6. Furniture - - -	293	17	7
	£9,374	8	1

To meet this outlay loans were obtained from the Loans Commissioners to the extent of 9,316*l.* at 3½ per cent., repayable in 30 years. The interest and repayment of principal amounts to an annual sum

of 630*l.*, which is met by a rate equal to seven-sixteenths of a penny in the pound.

As regards cost of maintenance it is not very easy to arrive at a definite figure in regard to a hospital which is liable to be occupied or not in so absolutely uncertain a way as this; but assuming the wards were empty for 12 months continuously, it is estimated that the cost of maintenance for that period would amount to 370*l.* This sum includes the following expenses:—clerk, medical officer's retaining fee, steward, matron, caretaker, out-door porter, nurse, rations for residents, coal, gas, and water, rates and taxes. For the statistics as to cost, and for much valuable information I am indebted to Mr. Alderman Wackrill, the Chairman of the Joint Board.

Local Isolation Hospitals as opposed to a Central Hospital.

BY

C. E. Few, Vicar of Seal, Sevenoaks.

It seems to me a question well worth considering, whether it is not on the whole far better to treat fever cases in the locality where they arise rather than to transport them to large central hospitals. I am speaking only for country districts, having no experience in towns; possibly there large central hospitals are best.

It is of course impossible to go into such a vast subject as this in the brief time allotted to those who have the privilege of reading a paper at such a Congress as that now assembled. It is only just possible to treat of some of the great pros and cons, and so leave the public to decide whether or no the present system is unwise, and needs consideration, and perhaps alteration.

All hospitals require careful management and supervision; this of course is possible in ordinary hospitals, as committees of laymen can visit and judge for themselves. In fever hospitals this is more difficult, especially in country districts. The hospital being probably placed in some out of the way place, and rarely visited by any except those in charge; the outside public being practically excluded. Local hospitals would naturally be more under supervision.

It is of the utmost importance to make the hospital system popular, because notwithstanding all Acts of Parliament, poor people cannot be compelled to have doctors at all; and many a case has been and will be hushed up and treated at home, particularly when children can be compulsorily removed to some out of the way distant place, to which the parents would have to walk and lose a day's pay if they wished to inquire.

Local hospitals would certainly minimise this difficulty; the position would be known; kindly local interest would probably do its best to make each hospital as complete and attractive as possible; and

the residents would have the feeling that all care expended on the hospital would be for the benefit of their own poorer neighbours; and the cottage owners in the district should be taught, that by arranging for local treatment they were but providing that spare room accommodation which they are able to enjoy in their own houses, but have, as a rule, failed to provide for their cottagers.

It must not be forgotten that the removal of patients can only be enforced where there are not *means for isolation at home.*

A large central hospital is doubtless damaging to the value of property, not only in the immediate neighbourhood, but in the district generally, inasmuch as all the fever of an area of perhaps some 15 or 16 miles in breadth is liable to be carted into it along the country roads.

If the fact of this central hospital would free the rest of the district, the argument that some rather than all should suffer might very properly be urged; but no one *pretends that this is the case,* doctors only speaking of moving about 60 per cent. of the cases; and if only five per cent. is left behind, it is enough to start all the mischief over again.

The ambulance risks are twofold; to the patient, and to the neighbourhood.

No bad case could be moved at all, certainly not for any great distance; and surely the risk of conveying infected people through village streets and amongst the ordinary curious people of the world must be dangerous; and certainly the law as to a zone of 40 feet cannot be observed.

The cost of a permanent hospital unoccupied must be a very heavy charge, and this, possibly, for months together.

Alternative Scheme.

The alternative scheme I would suggest is to map out every district, and to choose sites suitable for treatment of fever in a certain area; the smaller the better.

To prepare these sites as to drainage and water supply, and to place on each a small iron room, with walls about 8 feet high, to be used as a kitchen and laundry; the rain to be collected in a tank for washing purposes.

The sanitary authority should provide a certain number of portable hospitals, say two for each relieving officer's district, and two extra ones to be kept at the union house on a two-wheeled cart, like a lifeboat, ready for immediate transmission if required, to supplement the two local wards.

These rooms should be capable of holding three, or, at a push, four patients. If cottages could be secured for kitchen and nurse, so much the better; but if not, portable rooms suitable for the nurse should be provided, one for each relieving officer's district.

These sites might be in meadow lands, 40 feet from the road, the iron room surrounded with a barbed iron fence sufficient to enclose

it, with the understanding that, when occupied, the zone of 40 feet, if considered necessary, should be wired off. The nearest point on the road could be, when required, connected by a wire to run a basket on wheels for the transport of goods, and at very little expense a pipe could be laid from the road to supply drinking water from a water cart. The drainage should consist of two cesspools ready dug, one for slop water, the other for the infected sewage; the earth excavated should be kept dry and available for earth closets.

On these sites should be erected the portable rooms when required.

Should any kindly landowner wish to provide a site for his own particular district, in addition to the public one, he shall be allowed to do so on fulfilling the above conditions, and be supplied with the portable wards, *on the understanding* that his site becames, *pro tem.*, the official centre of fever for that area, and that all cases in that area may be brought into it during that outbreak.

By this means the whole district would have, as it were, skeleton camps arranged, and all provision made for invasion of disease, costing a mere trifle when unoccupied, and capable of almost unlimited expansion.

In case of a very severe outbreak, the medical officer of health can requisition the wards from other districts.

The Wards.—These should be bright, warm or cool, with non-absorbent walls, capable of frequent changes of air without draught. No better material is to be met with than that made by the Patent Wire-wove Waterproof Roofing Company, a strong wire-wove material, waterproof, tough; giving, when painted, a smooth glazed surface, most easily cleansed and disinfected, and a good non-conductor of heat.

The walls and roof should be double, with air space between, and the system of ventilating by Tobin tubes freely introduced. If the air can be frequently changed without inconveniencing the patient, there is not the same necessity for so large cubic space per patient.

The question of a room being too hot or too cold depends in a great measure upon its scientific construction, and the material of which it is made. Ice keeps better in lead than iron; a blanket would keep a can of water hotter, and a lump of ice longer than if either were placed in a brick cupboard; and even paper blankets are warm, or to speak more correctly retain the body heat. Hence, if you can find a good non-conductor of heat, however thin it may be, and construct the room with double walls and roof, with air space between, it would be possible for the temperature of that room to be very little affected by the outside temperature. Such a room could be kept warm by stoves in winter, and ought not to be baked by sun in the summer. A brick room exposed to the baking sun takes all the night to cool, whereas a thinner material would soon radiate the little heat it held.

In the Local Government Report, in speaking of temporary hospitals, cases are mentioned of patients dying of cold, and of water

freezing in rooms; the latter sometimes happens in well-built private houses; but if it does it must be somebody's fault; bad construction of room, insufficient warming apparatus, or inattention to fires.

Nor, again, need these portable buildings be heavy; a little science helps one in the construction, and a determination not always to build in the same groove.

I built a hospital that weighed only 13 cwt., 16 feet by 12 feet; three or four navvies had small-pox in it in one of the most exposed spots in Kent. I erected it myself in a storm of snow and hail about five years ago. Before it was erected on the spot one of the largest London builders sent his foreman to see it, who rather laughed at the slightness of my timbers. He went away and supplied a house, supposed to be like mine, using timbers at least three times as heavy. His house blew down in about a week; mine never did.

Unnecessary weight is a great mistake, particularly in a portable hospital. Thick timbers only warp and hold the damp; all you want is strength enough, and that judiciously applied.

These houses of wire-wove material can be constructed for about 6*s*. per square foot of floor, calculated to last for 20 years, at the cost of painting once in four. One, say 24 feet by 12 feet, could be erected in about 12 hours.

There is not, as a rule, such a desperate hurry; a doctor is cautious in pronouncing as to *the first* case of fever, and after the announcement there is always a certain amount of unavoidable delay before action can be taken.

It might be wise to engage one skilled nurse for the union; but this is not absolutely necessary. No difficulty has hitherto been experienced in procuring fever nurses when required. Moreover, in country districts, months of idleness and making gossiping acquaintances would be undesirable. A nurse in thorough training, and one who knows nobody is always the most efficient.

We come now to the relative cost. I take an estimate for a central hospital, say 2,500*l*. for 12 beds, because these figures have actually come before me, and are probably as moderate as possible, representing in the particular instance about 6*d*. per cubic foot. This figure included no water supply or purchase of site.

	£
Hospital for union, consisting of three relieving officers' districts, to hold 12 beds - -	2,500
	£2,500

That is, about 208*l*. *per bed.*

Six Portable Hospitals for same district (two for each district) about 70*l.* each - - -	420
Two extra ditto, 70*l.* each - - -	140
(These hospitals, holding three beds each, would make up 24 beds).	
Three houses for nurses - - - -	75
Preparing three sites, say 20*l.* each - -	60
	£695

Say 800*l.* for 24 beds; about 33*l.* *per bed*, or *one-sixth of cost* as compared with central hospital.

In my next remarks, I hope I shall not be misunderstood to be wishing to impose on my medical friends any additional gratuitous work.

There is no profession in the world, the members of which give up so ungrudgingly so much valuable time and energy to alleviate the ills of mankind as the medical profession, in England, or on the Continent, or in the civilised world.

I am treating the matter purely as a business question; and I am only endeavouring to provide local hospitals where patients can be treated far better than in their own homes. I am also assuming that most doctors would rather keep their own patients than send away to a distance where they could not possibly find time to visit them.

Central hospitals are attended either by a resident medical officer or else by some local practitioner, who for a fixed sum, say 10*l.* or 20*l.* per annum, and 1*l.* per case, undertakes the charge of the hospital.

In the local hospital system there would be *no medical fees or charge for drugs whatever.*

Patients would be of three kinds: those treated by their own doctors privately, those on clubs, those under the parish doctor. Hence, fever cases would be only a part of the duties of the medical men working in the district, and nothing could be charged to the ratepayers.

For argument's sake, assume the moderate number of 50 cases: under the central system there would be a charge on the lowest estimate of 60*l.* per annum, under the local system NOTHING.

This amount saved per annum would alone in 20 years renew the whole of the portable hospital wards and leave 400*l.* to the good.

People say that if there is so much difficulty in providing one site, so much greater will be the difficulty to provide many. On the contrary, I believe the smaller you make your area, the less will the opposition become. We do not mind nursing our own children in our own houses, but we should strongly object to having the children of others thrust in upon us. The ills of our neighbours, even from selfish motives, we are glad to endeavour to alleviate, and for them we might even run risks; but we are not called upon to do this for people living at a distance, just because their own neighbours will not look after them and provide the needful accommodation.

DISCUSSION.

Dr. Fosbrooke, Medical Officer of Health, Worcestershire County Council, said that the Worcester County Council directed the administration of three permanent and three temporary hospitals. His experience was that the latter were no more unsafe than the former. A fever hospital, like a fire-engine, in order to be efficient for its purpose must always be kept ready for instant use. It must be ready to receive the very first case of contagious disease that broke out. The reader of the last paper spoke of permanent hospitals as if they were always inaccessible. It was not uncommon, in his experience, for patients to go eight or nine miles to an isolation hospital, and he had never known of a case of injury arising in passing through towns and villages, or where the journey had caused the patients to suffer. He could not agree with Mr. Few that temporary hospitals would be more popular than permanent ones. Parents would readily enough send their children to a hospital where they were assured that the child would be better treated and receive more care than at home. The children also were very glad to go. There need be no delay in removing patients; it was only necessary to telegraph when a case broke out, and an ambulance was sent at once. At Droitwich they were going to do away with the temporary hospital in favour of a permanent one.

Dr. Nasmyth (Sanitary Association of Scotland) said he wanted to organise in his part of Scotland (Fifeshire) a combination hospital, in which the principles of the cottage hospital and of the isolation hospital could be conveniently combined. He would like to ask Dr. Thorne if he saw any objection to such a combination. He wished to know also what distance he would consider safe for the removal of cases.

Mr. Jeaffreson (Framlingham, Suffolk,) described the arrangements in practice at an isolation hospital at Framlingham, which had been formerly always known as the "Pest-house." It was very seldom they had a case, but they were always prepared, because they gave to the nurse a retaining fee in the shape of a garden and rooms rent free. They had also a permanent hospital, but the only difference between them was that in the permanent hospital beds were kept ready for patients, but in the pest-house there were no beds. Every fresh case required fresh beds, which would be taken away and destroyed when the patient had gone. When the pest-house had no patients it was absolutely empty. In rural districts such hospitals might be empty for years. A double treatment of that kind was the best practical solution of the problem. The nurse's fee would be paid by the parish when it was a parish case, and by friends of the patients when it was a private case.

Mr. T. F. Wakefield (Chairman of Health Committee of the Corporation of Richmond) said Richmond was still seeking a site for an isolation hospital. Several eligible sites had been offered, and would have been bought, but in every case the neighbouring residents protested against the hospital being built. The County Council was about to apply to Parliament for power to deal with the whole county in regard to provision of this kind. In Surrey only one-third of the population was supplied with isolation hospital accommodation. The County Council had interested itself in trying to solve the question whether some danger of infection did not arise from the use of the ambulance itself. Finding that the bearers and attendents were themselves not attacked by infection, they had come to the conclusion that the fear of infection from the use of

ambulances was not justified. The supposed difficulty in getting patients to a hospital was chimerical. With a proper ambulance it was as easy to go 10 miles as to go one. The speaker, in conclusion, called attention to what he said was an excellent brougham ambulance, which could be seen in Long Acre, at Davis's, the coach builder's. Other County Councils would find it necessary to do Surrey was doing, and they would do well to obtain powers from the legislature to deal with the question on a comprehensive plan. The best solution of the question was, in his opinion, a permanent central hospital. In his opinion, no hospital should be considered complete without a complete apparatus for disinfecting by super-heated steam. The expense would be prohibitory if such apparatus had to be multiplied in proportion to the number of temporary hospitals that would be necessary.

Alderman Ernest Day (architect, Worcester,) said he once held the same opinion as Mr. Few, but further experience with temporary hospitals had brought him to an opposite opinion. The prejudice against living near a permanent hospital was dying out, and people were found now ready to build right up to the walls of a hospital. The objections he had against Mr. Few's interesting paper were economical ones. On the score of economy, one central institution was far better than half-a-dozen temporary ones. Each would want a doctor, making six doctors instead of one. Two or three nurses might be sufficient for a permanent hospital, but six temporary hospitals would require six times as many. The materials and all the apparatus, as well as the staff, would have to be multiplied by six, and the sites, however temporary, would be very costly. A temporary building would require to be renewed every 20 years, but a permanent hospital might last for a century.

Dr. J. Maxwell Ross (Officer of Health, Dumfriesshire,) said he had been disposed to recommend six hospitals, viz., one for each of the six districts in his county, instead of one central hospital, and the present discussion would help him to mature his views on a question in which he was greatly interested.

Councillor John Atha (Leeds) said they had formerly found it difficult to dispose of the families of persons removed from their homes suffering from infectious diseases during the period necessary for disinfecting their houses. They had now adopted the expedient of providing a shelter, where the families of infected patients were sheltered and maintained until the doctor was satisfied that there was no danger to be apprehended from allowing them to return home. At first, the County Council exacted payment for the accommodation, but eventually they had decided that the public should bear the whole cost, since it was primarily for the sake of the public health that these people were forced to leave their homes temporarily. It was still a moot question with them whether it was not more economical to put up wooden buildings, which could be burned down when no longer wanted, or to build more permanent structures.

Dr. Thorne-Thorne, in replying, said he was so much in sympathy with Mr. Few in principle that he was sorry to have to differ from him *in toto* with respect to method. His plan of multiplying temporary hospitals would be a most expensive one, and it would probably be found that when everything necessary had been supplied to his temporary hospitals, ten times the estimated cost would be incurred. Dr. Fosbrooke had always been a difficulty in the way of the advocates of permanent hospitals, because his establishment seemed to be so successful, and was

so well conducted as almost to amount to a refutation of their arguments. Now that even Dr. Fosbrooke admitted failure, the question was settled. If wood were used in the construction of temporary hospitals they should be burned down; but they never were. The wooden buildings were left to rot on the ground, and he could show samples of wood from such structures which would horrify any sanitarian. A proper ambulance would be an excellent thing. It should be of simple construction, and should only require two movements in order to load and unload the patient—one push to get him in, and one pull to get him out. To properly warm wooden hospitals was very difficult. He had in mind such a hospital where, although they had killed two patients with the heat, they could not, even with roaring fires, prevent water from freezing at the bedsides of the patients. They must have thick walls if they were to keep out the cold in winter. In summer there was nothing like tent treatment. Permanent hospitals ought to be solid buildings, well constructed, and attractive.

The Rev. Mr. Few, in his reply, said he was satisfied to have been able to bring his scheme forward. No one had been able to dispute his main facts. Before a sound conclusion could be arrived at, the question would require mature discussion by the public. With regard to sites, they could often be arranged for in advance, to be only actually purchased on a future emergency. He had found that plan practicable in his own parish. Richmond was a town where the distances were small, and certainly a central hospital was best in such cases.

The Arrangement and Construction of Asylums.

BY

RICHARD GREENE, F.R.C.P., Ed., Medical Superintendent, Berry Wood Asylum, Northampton.

If it be desirable that the greatest care and judgment be brought into action in the construction of all large buildings, it is imperative that asylums for the insane should be above the suspicion of fault. Here large numbers of patients are kept in confinement. They have had no choice in selecting their place of residence, and no voice in fixing the duration of their stay. They are suffering from one of the greatest, perhaps *the* greatest, affliction that can befall a human being, and common justice requires that their terrible calamity should not be increased by unhealthy surroundings; but, on the contrary, that all the aids of hygienic and other sciences should be called in to lighten their burden and promote their cure.

It is sad to think of the condition of the insane in olden times. Suitable provision was not even dreamt of. Old prisons, monasteries, or, in fact, any building not good enough for anything else, was the lazar-house into which the poor lunatic was consigned. Indeed, it was not until the dawn of this century that the subject was seriously con-

templated with a view to reform, and by far the greatest strides have been made during the present reign—the Victorian era—which has to be credited with so much that is good in all departments of our civil life.

It may be said that the old asylums were simply conglomerations of buildings, without attempt at harmony, architectural effect, or hygienic conditions. Few examples of these exist in England at the present day, but in some continental countries they are common enough yet. During the early part of this century an Act was passed which rendered the building of county asylums, and of making adequate provision for the insane poor, incumbent on the various quarter sessions throughout England. It is impossible to refrain from stating that this duty was in most instances admirably performed by the county magistrates, and the modern English county asylum is an institution which is in all countries looked on as a model, both as regards construction and system of management. The visitor who for the first time inspects some of our provincial asylums will be struck with the beautiful sites which have been selected for them; with the carefully laid out grounds and recreation courts; their comfortable, almost luxurious appearance, and with the freedom which the patients almost universally enjoy.

The only building to which a modern county asylum can be compared is a general infirmary, and even here there are many points of difference. These points are more noticeable on an internal inspection than on an outside view, and they are caused by the different objects which have to be kept in sight when the buildings are being designed. A very good hospital might prove an indifferent or even bad asylum, and a good and well-planned asylum would be a second-rate hospital. The grand distinction between the two is that in the hospital the majority of patients are in bed during both day and night, whereas in asylums the majority are up by day. Also, an infirmary does not require single-bedded rooms, while in an asylum at least one-fourth of the numbers should be accommodated in rooms having only one bed. These conditions render the designing of an asylum a much more complicated work than that of an hospital.

The site of an asylum should be carefully selected, and a gravel soil obtained, if possible, but inasmuch as an asylum should occupy a position somewhat centrally disposed to the population from which it draws its patients, it is evident that the desirable soil cannot always be obtained, at least it cannot always be had at a reasonable price. When, therefore, the building has to stand on clay, the most careful and thorough subsoil drainage must be carried out.

Some authors have described a variety of insanity as "phthisical insanity." Whether it is perfectly correct to so describe it I am not at all sure; but it is certain that the insane suffer from tubercle more frequently than the population generally; and as it has been proved that sub-soil drainage lessens the mortality from consumption, the point needs no further argument to enforce it. The group of diseases coming under the name of "rheumatism" is also greatly modified by the nature of the soil.

In England it is important to avail ourselves of every gleam of sunshine vouchsafed to us. A southern aspect should therefore be insisted on, and the building should be placed on gently rising ground not too high above the sea-level, as exposed sites are apt to be cold during the winter months for an invalid's residence.

The amount of land should be sufficient to protect the patients from the gaze of the inquisitive; but a large estate is neither necessary nor desirable. High roads and public footpaths should be at some little distance.

In many districts stone is to be had cheap for building purposes, and in these cases it will most likely be used for asylum construction; but perhaps the majority of our asylums are built of brick. We have outlived the time when "Capability" Brown said that "a red brick "house puts the whole valley in a fever"; and when Repton called a brick house "a scarlet sin against good taste." Our views have changed for the better since 1773, when Brown died, and we now think that a well-designed brick house improves a landscape, especially if it be made of the beautiful plum-coloured bricks common in Queen Anne's time; but not so easily obtainable now. Whether brick or stone be employed the quality should be of the best. Porosity, or a tendency to scale or crumble should be guarded against, or the wall will prove damp. In some counties it is the custom to have the outer walls made with an air space of two or three inches. This not only prevents the damp from penetrating, but it has a tendency to equalise the temperature of the ward. Perforated bricks make a wall which is at once strong, light, and dry.

The inner walls should be plastered throughout, or, preferably, covered with Portland or parian cement. It is not on æsthetic grounds only that I insist on this, but for sanitary reasons also. The joints of brickwork can never be made perfectly smooth. Dust collects in the grooves and irregularities, and dust too often means disease. A skirting-board implies that there is a space at its back for collecting dust and dirt, and for affording a pleasant playground for rats and mice. It should be abolished, and a strip of wood about two inches wide and one inch thick nailed to the floor close to the wall.

The space between the foundation walls should be filled in, and a thick layer of concrete should rise to within an inch-and-a-half of the floor level. On this concrete wood blocks should be laid, a thick layer of Stockholm tar being placed next the concrete. By these means neither damp, sewer gas, nor vermin can get under the floor. It is also both warm and the tread noiseless—important points in asylums and hospitals.

The favourite kind of window at present is the ordinary double hung sash window. Why it should be the favourite is not easy to see.

In asylums it has to be blocked both top and bottom, merely allowing an opening of about four or five inches. The consequence is that the amount of air admitted is insufficient in warm weather. Further, it is most difficult to keep clean. Dirt accumulates between the sash and the frame, and the cords are constantly breaking. A

modification of the French casement is much to be preferred. The upper part should be an oblong swivel, or hinged fanlight, and the lower divided at its centre by a strong mullion; the sections being fitted with sashes moving on central pivots. An asylum needs abundance of light, and the windows should be more numerous, perhaps, than in any other building. Unfortunately, the amount of glass necessary for light is apt to make the wards somewhat cold in winter. It would be very desirable to have all the windows double, and in this case the inner window might be on the double-hung sash principle. No blocks would be necessary, and ventilation, without draught, would be easily maintained. Wherever practicable the windows should be placed opposite to each other, and the width of the room should rarely exceed 25 feet, or perflation is likely to be imperfect. The upper panels of the doors should be, almost without exception, of strong plate-glass, and the lower panels of open ironwork, fitted in some cases with light wooden shutters.

The staircases are almost invariably of stone. In most asylums they are too narrow, and the risers too high.

In designing any building the first principle is, that it be perfectly adapted for the purpose in view, and no flight of genius on the part of the constructor can justify his swerving for a moment from that principle. If the edifice can be made beautiful, so much the better; but beauty must be made subservient to utility and to hygiene. It is often justifiable to decorate construction, but hardly ever to construct decoration. What then is the best design for an asylum for the insane? The old conglomerate style is gone for ever, and the linear is fast following it. Nevertheless, there is something to be said in favour of the latter, especially if the word "linear" be not too literally interpreted, and the less important wards placed in *échelon*. It is, however, not very suitable for asylums exceeding 300 beds. Nowadays the block system in one of its many forms is that which is almost invariably followed in the construction of asylums of 500 beds and upwards. There are five chief ways in which the blocks may be arranged.

1st. The blocks are placed on either side of a straight corridor of communication. This does not look well in elevation, and it covers much ground, but it is a simple form of construction, and might be found really good from an hygienic point of view, because the circulation of air would be free, and the drainage easily arranged.

2nd. There is the broad arrow form. Here the straight corridor is, if I may venture to say so, bent at its centre and the blocks arranged in *échelon*. I am inclined to think that this plan is better adapted for an hospital than for an asylum. The difficulty of supervision must be great, at least in large asylums.

3rd. We have the corridors arranged in the form of the letter H, the blocks being attached to the free sides of the letter. In my opinion this is an objectionable form.

4th. The blocks are arranged in quadrangles, or rather parallelograms; the important blocks facing due south, and the other blocks having their ends south and their sides east or west; the administration portion of the asylum only being to the north. Several asylums have lately been built on this principle, and for compactness and facility of supervision it is unrivalled.

5th. We have the horseshoe form of corridor with the blocks placed all round the outer edge. It is probable that this principle will ultimately be developed into the best plan of all.

A detached hospital for infectious disease should form part of every asylum.

The height of a building will profoundly affect its hygienic qualities, because the higher it is made the greater will be the interference with the circulation of air around the ground floors; the greater will be the difficulty in lighting and ventilating the corridors of communication, and in securing perfect sanitary arrangements throughout. I have, therefore, no hesitation in stating that an asylum should never exceed two stories in height, and if any part of an asylum be three stories in height, the whole building may be described as faulty or unsuitable. Apart from the sanitary aspect of the question there are reasons why no part of the building should be three stories, but these objections are scarcely relevant here. I should, however, like to go further and affirm my conviction that a one-story building would be by far the best, whether viewed from a point of management as regards the staff; of comfort as regards the patients, or of ease in carrying out the principles of modern hygiene. Of course the objection would be at once raised that the amount of land covered by the building would be enormous. My answer to that would be that a one-story building for 500 or 800 patients would not need more ground space than one of two stories for 1,000 or 1,600 patients, and many of our public asylums exceed even the latter number. If I say that no asylum should exceed 800 beds I do not think I shall find my assertion contradicted by anyone conversant with the inner working of such institutions.

Whatever form of construction be adopted the blocks will be so arranged as to lie around, or on either side of the administrative department, which thus forms the centre, and contains the various offices, including a large recreation hall.

The patients' blocks will be divided into day-rooms and dormitories. The former will vary in size, containing from 10 to 50, or, perhaps, 100 patients; the latter will range from three-bedded rooms to those in which 100 may be placed. The size is somewhat important, as it is always difficult, and sometimes impossible, to provide efficient cross-ventilation in small dormitories. Probably those containing between 20 and 30 beds will be found the best. As I have already said, about one-fourth of the dormitory space should be in single-bedded rooms.

As regards the cubic space allowed per patient in a county asylum, it is in all 1,080 cubic feet, 600 being allotted to dormitory and 480 to day-rooms. The superficial space is 50 feet for the former and 40 for the latter. It follows, therefore, that the rooms are usually 12 feet high. This total of 1,080 cubic feet is by no means excessive; but it may be sufficient, provided the air is very frequently renewed. As each individual renders impure between 2,000 and 3,000 feet of air every hour, it follows that the air in asylum dormitories must be renewed from four to five times every hour, and this renewal of air is one of the most difficult problems with which the medical superintendent has to deal. In summer it can be managed, provided the external air is not perfectly still,—a condition which does not often continue many hours at a time in England,—but in winter, when the air is cold, and when the low nerve force of the lunatic has to be considered, the question bristles with difficulties, and I doubt whether any very satisfactory solution of the problem has yet been found. Abundance of open fires would meet the difficulty, but apart from the expense of such a system, it could not be carried out safely in dormitories occupied by the insane. Hot air may be supplied by one of the various slow-combustion stoves, by hot water or steam pipes, or by driving hot air into the rooms by means of fans. All these methods, however, provide warm air, and the patient is thus compelled to warm his body with the air he breathes —a proceeding wholly opposed to both the teachings of nature and to the principles of hygiene. I have elsewhere admitted that this artificial way of warming dormitories and day-rooms is often the least of two evils; but it must not be pushed; must be carefully watched, or a high death-rate from consumption may be expected. The fan system possesses one advantage over the others, namely, that in warm weather pure, cold air may be driven in, and thus other means of ventilation may be supplemented. There is, however, nothing special in the ventilation of an asylum.

The same may be said concerning the disposal of sewage, and the arrangement of baths and closets. The latter are usually placed in small blocks in rear of their respective wards. Care should be taken that the connecting passage between the wards and the closets is short —not exceeding a few feet—because if it be long there is some danger of it acting as an extraction flue, and by drawing the foul air into the ward increasing the very danger it is intended to prevent. A stove placed in the closet block would obviate this risk. A well equipped Turkish bath should never be omitted.

The main flue from the furnaces should be carried underground for some distance from the building, and the chimney should rise high enough to carry the smoke well clear of the grounds. It is a good plan to make use of the chimney as a sewer ventilator, and for this purpose a 12-inch pipe should be taken from the highest point of the main drain to the base of the chimney.

Much of the health of the patients will depend on an abundant supply of pure water. It should not be less than 30 gallons daily for each patient.

The electric light has not as yet made much way in asylums. Its gradual introduction is certain, and with the abandonment of gas another element of danger will be banished from the lives of the insane.

It will be gathered from what I have said that the hygiene of an asylum closely resembles that of any other large building. It is somewhat more difficult to carry out; but the special points are few, and need little emphasis to impress themselves on the minds of those conversant with the principles of general hygiene.

Construction and Arrangement of Asylums.

BY

G. T. HINE, F.R.I.B.A.

Asylum construction differs from other branches of architecture in its relation to hygiene in that it demands a consideration of the mental as well as of the physical welfare of the people, and no architect can hope to attain much success in asylum construction, who does not devote some study to the nature of the malady and habits of the unfortunate class for whom he provides accommodation.

The old days of prison-like cells, iron fetters, and strait waistcoats have happily passed away, but still there is much to be done by way of improvement; and an architect may assist materially in lessening the troubles and contributing to the cure of these poor people by the care and consideration he gives in providing them with bright and healthful homes, from which the idea of detention is as far as possible removed.

Unfortunately he has too often to contend with the objection that asylums are provided out of the county rate, and that his duty to the ratepayer demands that cost should be a first consideration. Unlike the hospital, where only physical disorders are treated, and a simpler form of construction is required, the lunatic asylum has not the pecuniary support, and therefore, to a less extent, the sympathy of the public; and too frequently an architect's first instruction is, that the cost per bed must not exceed a figure which is more applicable to the workhouse than to the hospital.

But in these days of progress, it is coming to be understood that we can do better service to the ratepayer by giving first consideration to other points than that of mere cost, and that in providing buildings skilfully designed and well constructed, we afford the best opportunities for successful treatment and speedy cure, and thus are studying the truest economy.

In the short time allowed me for this paper I must restrict the interpretation of my theme to its narrowest limits, and regard the

asylum as meaning only the pauper institution, and not the hospital for private patients. The first principles, however, of arrangement and construction are more or less observable in all forms of homes for the insane, and if we allow a somewhat more luxurious development in the private asylum, we might fairly apply the following observations all round.

Before touching upon the construction of asylums I ought to say a few words on the selection of a site, though unfortunately it rarely comes within an architect's province to advise about this; generally the site is purchased before the architect is called in to design, or compete for the erection of the building.

A word in passing about competitions, which are unfortunately gaining ground—I say unfortunately, because they are not always calculated to produce the best results. Too much importance is attached to the mere design, without regard to the details of construction, or the practical experience of the author; and it not unfrequently happens that a good workable plan has to be sacrificed to the symmetrical outline, necessary to make it attractive *on paper* and give the author a chance of success.

A site should, in my opinion, be, firstly, on high ground. I believe, in a mentally hygienic sense, much depends on elevation. It is a known fact that in some parts of the world the intellectual standard is lower in the lowlands than in adjacent higher districts; and I should much like to see some statistics of cures effected in asylums on elevated situations, as compared with others on lower ground. Secondly, the soil should be dry, and sufficiently porous to allow of the sewage being used on the land; and thirdly, an abundant supply of good water should be available.

If the site is on a slope, it should be a southern one, or should allow of the rooms constantly occupied by patients facing the south or south-east. Sunshine is a necessity where the relief of mental depression is aimed at, and care should be exercised in reserving the best aspects for the patients' *day* rooms.

In the general arrangement of an asylum, the first question to be determined is the principle on which it should be built. In this country asylums are built either on the "pavilion" principle, where the different blocks are connected together, and communicate with the administrative centre by one-story corridors, or as continuous buildings; the latter being the most common and convenient plan for small asylums. Another form of asylum of recent adoption in America, and on the European continent, is that of entirely detached blocks, placed more or less distant from the central or main building, comprising a number of villas, in which patients can be very effectually segregated. It is claimed that the curative results are higher in this than in any other form of asylum; but I hope we may have a description of these buildings from some of our distinguished visitors, and I shall confine myself to the principles of construction known and adopted in this country.

When the principle is determined, the first care should be to arrange the wards in the best positions for aspect, light, and air, and all within easy reach of the administrative centre. In small asylums this is a comparatively easy matter, but in buildings accommodating from one to two thousand patients much consideration is required to succeed in all these respects. It is also important that the wards should be arranged so that the medical officers in their rounds may not have to retrace their steps unnecessarily.

The position of the wards is a matter of equal importance the day-rooms should all, if possible, have a southern aspect, certainly every ward should have one or more day-rooms to the south; and the blocks should not be built to look out on to one another. In large asylums this almost necessitates a plan on the "echelon" principle; and in *very* large buildings even this requires modification, or the length of the corridors would become quite impracticable.

On the classification of patients, and the positions of their various wards, much of the convenience of working depends.

In all asylums, unless built for special cases, there should be accommodation for the following:—

1. Sick and infirm, including a small ward for newly-admitted patients.
2. Acute or refractory cases.
3. Epileptics.
4. Quiet and working patients.

Some of these wards, again, admit of further sub-division, but the first and second should always be designed to allow of classification by providing two or three day-rooms in a ward, with one or more dormitories on the same floor, in addition to a proper proportion of single rooms.

The infirmary wards, which, including the reception ward, should generally provide accommodation for one-fourth the total number of patients, are best placed nearest to the administrative centre and to the medical officer's rooms, and should not exceed two storeys in height; or, if three, the top floor should be devoted to dormitories for quiet patients. Each ward should be self-contained on a floor, and should comprise one or more roomy dormitories, one with a southern aspect for bedridden patients, and with windows on at least two sides to allow of cross-ventilation, as indeed should be the case in *all* dormitories where practicable. The superficial area and cubical contents of these rooms should very much exceed those occupied by healthier patients (the Lunacy Commissioners say one-third more); at least two comfortable day-rooms should be provided for convalescents, one especially for dining in, as these patients rarely go to the general hall for this purpose.

The number of separate single rooms in an asylum is a point about which there is much diversity of opinion, and must to some extent be determined by the character of the patients. Generally, if the dormitories are numerous, and moderate in size, single rooms for one-fifth of the total number of patients will be considered sufficient, but

these must be judiciously distributed in something like the following order :—

Acute and refractory cases -	1 single room to every			3 patients.
Epileptics - - -	1	„	„	5 or 6 „
Infirm - - -	1	„	„	6 or 7 „
Quiet and working - -	1	„	„	10 „

Single rooms should have shutters to the windows, and, except in the infirmaries, where one or two may conveniently be provided with open fireplaces for special cases, no single room should be warmed n this way. It is essential, however, that *every* apartment should be warmed and ventilated with proper inlet and extraction flues, of which more anon.

Doors *without* inspection holes or shutters are, in my opinion, best. In epileptic wards a narrow panel or other clear opening must be left to allow of an attendant hearing a patient when in a fit; but in other cases I think inspection holes or shutters suggest espionage, and are therefore undesirable, particularly as it is an easy matter to use a silent lock actuated by the handle, when the door can be opened as easily as a shutter, without disturbing the patient.

But to return to the infirmary. This should have, in addition to the single rooms last-named, rooms for attendants in proportion to the number of patients, excluding night attendants, who should be housed in a block by themselves in a quiet quarter; also lavatories, store rooms, and water-closet annexe, in common with all the other wards; and in addition to these, bath and dressing rooms. The other patients in asylums of any size will usually bathe in a general bath-house, but infirmary patients should have separate bath-rooms in their wards.

Each ward should also have a scullery, fitted with a small range, washing-up sink, and cupboards for crockery and utensils.

The water-closet annexe in the infirmary, as in all other blocks, should be constructed in a spur, separated from the building by a cross-ventilated passage. It should include closets, in the proportion of one to 10 or 12 patients, with an additional one for attendants, a small room for slop-sink and brushes, another for dirty linen, a coal place, and, on the male side, urinals. In addition to the general annexe, large dormitories in the infirmary wards should have a water-closet and slop sink attached, but separated by a cross-ventilated neck or passage.

While on the subject of closet annexes, I will refer to one or two special details of construction, as it will be impossible, in a short paper like this, to speak at length on all such matters. It is assumed that any architect entrusted with the erection of an asylum is well versed in all the leading questions of sanitary science.

The walls of all these offices should be faced internally with glazed bricks, or lined with enamelled tiles, which, though costly in construction, are easily washed and kept sweet and clean, and never require any outlay in paint. The floors should be of concrete, tiles, or some equally imperishable material not affected by wet. The doors of water-

closets should be low and raised a foot or more from the floor, to allow of observation, and should open outwards. The closet apparatus should be of simple construction, without valve or anything to get out of order. I prefer a hopper basin, straight down behind, with earthenware trap all in one piece, rather than a "wash-out" basin—a good quick acting cistern with large service pipe, but *not* with automatic action. Patients should at all times be encouraged in habits of cleanliness and order; and by automatic contrivances which relieve them of responsibility it seems to me you frustrate rather than encourage a healthy condition of mind. The objection of an occasional unflushed basin is a trifling matter, and one quickly remedied by the attendant. Urinals are best with only a back and an open channel, without wings or splash pieces; the less surface there is to wash the less chance of smell.

Next to the infirmaries should come either the ward for acute cases or for epileptics. In a small asylum the latter might be on the ground floor, with a ward for acute cases over; but, in any case, epileptics should, if possible, be housed both day and night on the ground floor. Their wards should be bright and roomy, the day-rooms rectangular, without breaks or obstructions, behind which a patient might get lost sight of while in a fit. There is not the same advantage in subdividing these rooms, as these patients are generally quiet, and, in their healthier moments, are more rational and appreciative of surrounding advantages than other classes of patients. The adjuncts to the ward should be the same as in the infirmaries, but with only one bath in connexion with the dormitory, for cases of emergency. The dormitory should be spacious, and large enough to hold fully five-sixths of the patients in the ward, the remainder sleeping in single rooms, which, unlike other wards, should open out of the dormitory; one or two only opening out of day-rooms for the use of troublesome or invalided patients during the day.

The ward for acute cases may be situated either on ground or first floor, if made sound proof, to prevent the disturbance of patients in rooms above or below. This ward is best broken up by dividing the day rooms into several smaller rooms by partitions partially glazed, so as to allow of the charge attendant controlling the entire ward. The single rooms, accommodating one-third of the whole number of patients, should open out of the day-rooms. There should be one or more associated dormitories on the same floor for troublesome cases; the remaining patients sleeping on the top floor of the building. In other respects this ward need not differ from the infirmaries already described.

The wards for quiet and working patients, or as they are generally somewhat erroneously termed, "chronic cases," may be very simple in design and arrangement. Were it possible to construct the entire asylum on this principle—as are those for imbeciles, built by the Metropolitan Asylums Board—that great desideratum, a cheap asylum, might be more readily obtained.

These wards may consist of large day rooms, with associated dormitories of proportionate size, and a small number of single rooms. The dormitories may all be on the top or two upper floors.

A specially roomy boot-room, which I have omitted to mention as attached to all wards for outdoor boots, hats, and cloaks, should be situated near the outer entrance, with some lavatory basins for patients to wash in when coming from the workshops or off the land.

In addition to the foregoing, it is often convenient to have wards of simple arrangement in connexion with the workshops on the male side, and the laundry on the women's side.

Before leaving the wards, I should add, that, whether built on the block or continuous-buildings system, they should always be carefully designed with reference to the position of staircases, both for convenience of visiting and for affording means of escape in case of fire. No ward, particularly on the upper floors, should have less than two exits, at opposite ends, making it impossible for any patient to be cut off from escape.

Staircases should be of ample width, and easy of ascent, and always of non-combustible material, for which purpose concrete is better than stone.

It is scarcely necessary to say that floors constructed on a fire-proof principle offer many advantages both against the spread of fire and the conduction of sound, and do not add so much to the cost of a building as is generally supposed. The Lunacy Commissioners require that the ceiling next the roof of all rooms occupied by patients shall be of fire-proof construction, and therefore, in two-storey buildings only one more floor remains to be of similar construction to make the building entirely fire-proof.

Coal lifts are sometimes introduced in asylums, but, in my opinion, are better omitted, as being dangerous, and also as robbing patients of work which they can generally well do. Sometimes I provide an outside staircase to a coal place in the W.C. annexe, the inner and outer doors of which have different keys, thus allowing coal to be brought by men to the women's side without their being able to get into the ward. These staircases also constitute additional ways of escape in case of fire.

The administrative department should be centrally situated between the male and female blocks, and arranged to allow of easy aproach to the recreation hall, kitchen, stores, and laundry buildings from both sides, without the two sexes coming into contact. It should comprise—

1st. A large hall for recreation purposes, capable of seating fully half the number of patients in the asylum, in which a stage should be arranged in a recess at one end, with convenient approaches and dressing rooms.

In small asylums the hall is frequently placed on the ground floor, with the chapel over it, this being convenient for approaches, and also economical in construction.

2ndly. A good kitchen, with sculleries, larders, and pantries sufficient for all patients and officers in the asylum, and near to the recreation hall, if this be used as a dining room. In some asylums one or

two large patients' dining halls are provided in addition to the general hall, when this is used exclusively for recreation purposes. Mess rooms for attendants and nurses should be situated near the kitchen.

3rdly. A general or steward's store, which, like the other buildings, should be easily accessible from both sides, and also have a cart road approach for delivery of stores.

4thly. The laundry buildings, which, if not quite central, should be on the women's side, but with a direct approach from the men's wards, and should comprise wash-house and ironing rooms, foul wash-house, and, in large asylums, separate wash-house for officer's linen; also, drying stoves in each of the wash-houses.

An admirable system of drying, which I first introduced at Nottingham, and am now using in two other asylums, is obtained by blowing or drawing warmed air through the horses by a fan. The clothes are thus dried much quicker, and with a fresh and sweet result. I find at Nottingham that before all the horses are filled, the clothes are dry on the first horse, and thus a constant succession of changes can be made, and the clothes dried as quickly as they are washed.

5thly. The central buildings should also include, near the principal entrance, one or two good visiting rooms; also committee, waiting, and porters' rooms, a superintendent's office, and rooms for the assistant medical and other officers of the asylum.

The superintendent's house, which, in many asylums, is incorporated with the central block, should, in my opinion, be an entirely detached building, or, at the most, be connected with the asylum by a corridor of some length.

The responsibilities of a superintendent make it very desirable that he should at times be able to shut his mind to his work, and this he could do more effectually if his house were some little distance from the asylum. Moreover, if a married man, it is not fair to his family that they should be brought up in close association with the asylum and its influences; and I venture to think further, that a superintendent's work would generally be better done with his office in the asylum and his house some little distance away, and without any corresponding disadvantages, providing that a telephonic or other means of communication be arranged between his house and the asylum, and that one or more assistant officers sleep in the main building.

The position of the chapel is another vexed question. It should be designed in all respects to convey to patients the idea of church, and for this reason is better a detached building in the grounds. On the other hand, it is very undesirable in wet weather to have to take several hundred patients some distance to church. When possible it is best to erect it outside the main building, with a connecting corridor in addition to outside entrances, either of which may be used.

Separate blocks for nurses and attendants, containing sitting and club rooms, where they can associate when off duty, with bedrooms above for those who do not sleep in the wards, are very desirable adjuncts.

A dispensary is always required; and sometimes an operating room, with one or two sleeping rooms adjoining, is a great convenience, indeed, almost a necessity in a large asylum.

Workshops should also be provided on the men's side, with separate shops for different workers, the variety and size of these shops being governed by the number and class of patients; and, in country asylums, farm buildings in a convenient part of the estate.

An isolation hospital, a short distance from the main building, should be constructed for infectious cases; this should comprise an associated dormitory with one or more single rooms on each side, a kitchen, laundry with disinfecting stove, and other necessary adjuncts.

Mortuaries for both sexes, with *post mortem* room, should be in a separate block, away from the main building.

I have, I fear, already exhausted more than my allotted time, and I dare not trespass further on your patience by saying anything on details of construction or internal fittings, though very much of the success and comfort of an asylum depends on the consideration given to these details. Nor have I time to touch upon the subjects of drainage and disposal of sewage, water supply and service, lighting, by gas or electricity, all of which are matters of much interest, and with which the asylum architect must be well conversant. One further subject which I must refer to, is that of heating and ventilation, which is so all important a matter in asylum construction that my paper would be incomplete without it.

In my opinion any system for warming and ventilating should fulfil the following conditions:—

1st. It should offer the least risk of injury to patients by accident or danger to the building by fire.

2nd. It should be under the perfect control of the engineer, who should be able to raise or lower the temperature in any ward readily.

3rd. One system should combine the double duty of warming and ventilation.

4th. Ventilation should not be dependent on natural atmospheric action, which cannot always be relied upon to create a circulation of air.

5th, and lastly. It should be reasonably economical in working.

After long consideration, and some years of experience, I have come to the conclusion that the right system is one of air warmed over hot water or steam pipes, and propelled into the wards by a fan, through underground trunks, and vertical flues in the walls communicating with all the rooms, and a similar system of extraction flues, by which the vitiated air is expelled.

It must be understood that I do not advocate air warmed by fire heat, a method which may seriously deteriorate its quality, a result not to be feared by warming over steam batteries, which plan has the further advantage of allowing the temperature to be quickly raised or lowered in any particular ward by a simple arrangement of pipes and valves.

I cannot attempt to describe my system in detail, but will merely call attention to a few important points.

The air which is propelled into the building must be drawn from a situation untainted by obnoxious surroundings.

The trunks and flues must be carefully calculated in proportion to the size of each room. Many failures in ventilation are due to ignorance or neglect of this.

Separate trunks for day and night service should be arranged, with simple shutter valves for closing the one and opening the other at morning and night.

The extraction flues should communicate with upcast shafts of some height, say in towers, to carry well away the vitiated air.

The fresh warmed air should enter the rooms near the top, and the vitiated air be withdrawn near the floor; experience having taught us that this is right; for, if the positions of inlets and outlets were reversed, some deleterious gases would not readily ascend to escape at the top, while the warm air, entering at the bottom, would quickly ascend and pass out without mixing thoroughly with the surrounding atmosphere, as it must do if driven in at the top, and be allowed to spread over the whole surface of room, gradually falling as more air is forced in above it, and vitiated air extracted below.

When ventilation is required without heat, the fan may be used to drive in air at its normal temperature, the stagnant atmosphere in the rooms being of necessity displaced either through the extraction flues or the open windows.

One great advantage of this system is, that heat can only be obtained in conjunction with ventilation, which is not always the case with steam or hot water pipes *in* the wards, where a close stuffy heat is generally the result.

I cannot better illustrate the results of this system than by quoting from a recent report of the Superintendent of the Nottingham Borough Asylum, where I have lately introduced it in the new male annexe.

"So efficiently has the heating been done that a temperature of "60 degrees has been easily maintained throughout the wards without "the aid of any fires, and this when the thermometer outside registered "10° of frost. The dormitories and single rooms are just as easily "warmed at night.

"Those who are acquainted with the working of an asylum will "readily imagine the immense comfort of being able to do without fires "in the wards. There is no crowding round the fireplaces, and no "quarrelling for the best seats, but the patients sit scattered about at the "windows and at the tables, just as in summer. It was expected that "there would be some grumbling at first at the absence of fires, but, "strange to say, I don't think I heard a single complaint. Another "great advantage this system of heating has over most others is, the "entire absence from the rooms of all pipes and other heating surfaces.

"The ventilation is also equally successful. It is very observable "in the dormitories and single rooms; the air in these appears to be "almost as pure in the morning when the patients get up as in the "evening when they go to bed."

1 p. 1921. A.

In conclusion, I must express my regret at the time I have been compelled to take in order to describe, but briefly, the arrangement of an asylum. There are very many interesting points of detail and construction I should like to have referred to had it been possible. I hope, however, my shortcomings will be remedied by others present in the discussion which is to follow.

DISCUSSION.

Dr. Saunders (Medical Superintendent of the Sussex County Asylum, Hayward's Heath,) said that in the arrangements of asylums there was nothing more important than the water-supply. If the site was not good the water would often get polluted. The selection of a site was, therefore, also a most important matter.

Mr. Banister Fletcher (Professor of Architecture and Building Construction, King's College,) pointed out what seemed a little like a contradictory statement in Dr. Greene's paper. In one part of it, double-sash windows were condemned, while a little further on an opinion was recorded in favour of the double-hung sash principle. He wished to ask Dr. Greene whether the 12-in. pipe for air referred to in the paper was to be connected with the base of the chimney.

Mr. Rogers Field, M.I.C.E., said that mere design in the arrangements of an asylum was in the province of the architect rather than in that of the engineer; but the water-closets and the sanitary arrangements generally were matters for the engineer. The first question was, how were they going to treat the inmates of an asylum? Should they be treated as responsible persons, or were they to be treated as not rational beings? Were they to use a pull in the water-closets, or an automatic apparatus acted upon by the door or the seat? Were they to mistrust the patients, or were they to employ apparatus to be worked by the patients themselves? He agreed with Dr. Saunders in thinking that to treat the insane as irrational beings was not the right way. Two types of apparatus had been tried. Where the ordinary pull was employed, it had at first to be worked by the attendants, but after a time the patients learnt to work it perfectly. Everything he had seen in the last 10 years confirmed him in the opinion he had long ago formed, that patients in asylums might be trusted to use the ordinary apparatus. If the flush was automatic, working through the movement of the door or the seat, the apparatus was always getting out of order. He had been appointed to report upon the sanitary arrangements at a well-known asylum. In the examination he had made he found that three-fourths of the automatic flushing apparatus were not acting.

Mr. W. M. Mackison (City Engineer, Dundee,) preferred that the windows in asylums should have, not a southern, but a western exposure. As the prevailing winds were those blowing between east and west, the western aspect was the most salutary. He agreed with the author of the paper with regard to the tiling of walls. With respect to the ventilation of buildings, he had no faith in apparatus for extracting air, because they caused a draught, and a draught was always bad. In a hospital with which he was connected they took pure air from a high tower and admitted it into the wards through an inlet placed about 6 ft. above the patient's bed, and also by an inlet placed below the level of the bed. Fires were of no use except to give a cheerful aspect to the wards.

Sir Robert Rawlinson said that with regard to the position and arrangements for water-closets in asylums, there was necessarily a great difference in different asylums. In some the patients could be trusted, but in others not. Some patients would get their hands down into the pan if they could. Such patients should be specially provided for. With regard to earth-closets, which the Government wanted to see introduced, generally there was again trouble with the class of what were called "the dirty" patients, who smeared everything within their reach. They had tried railing round the seat, with a 10-ft. fall below, so that such patients could not get at the excreta, but they found that more water was wasted in cleansing and keeping clean the apparatus than flushing apparatus would have required. Many years ago at Wakefield Gaol, where the prisoners were treated on the separate and silent system, there was a great outbreak of typhoid fever. The result of an examination by medical experts was an utter condemnation of the whole building, root and branch. After a brief examination, he found on each side of one end of a dividing wall a pan-closet, each closet being connected with the sewer by a 4-in. pipe, running straight down the wall into the sewer, which was never cleansed nor flushed. The criminals found out that by lowering the trap or pan and holding their heads down over the container they could converse through the closets with the prisoners on the other side, but while doing so they were breathing the sewer-gas, and hence the outbreak of typhoid fever. He examined the drains, and directed a 4-in. pipe to be continued up to the eaves to carry up the foul air. He found that the drains could be kept clean by flushing. The governor of the gaol invented a pan which, by means of a 4-in. lip, rendered it impossible for a prisoner to get his hand down or to remove the trap. These alterations, though simple and inexpensive, were effective, the infection disappeared, and the authorities were spared the great expense of a new prison. The flushing tank was, he felt bound to say, one of the greatest inventions of modern sanitary science, and it owed its progress more to Mr. Rogers Field than to any other sanitarian. The fame of the invention would long outlive the inventor. The benefit of a circulation of air could not be overestimated. At night his window was open (with Venetian blind down), and he thanked God that no window he ever knew of was air-tight. Windows with 6-in. beads at the bottom, so as to allow of being opened at the meeting-rail, were no danger even in winter. The air in rooms provided with them was always sweet.

Mr. H. H. Statham said he was glad to hear the remark with regard to the admission of air at the lower part of the room, and he rose to support it. In admitting air at the top they were opposing natural action, but in admitting it at the bottom natural action was helped. Fouled air always had a tendency to find its way to the top, and to bring the fresh air from the top was to bring it through the stratum of fouled air, some of which it would drag down with it.

Mr. Blair (Borough Surveyor of Bootle) said there were two well-known plans of ventilation, the first being that by which the air was extracted from the top; and the second that by which it was extracted from below. He had experience of two police-courts in which these plans had been respectively carried out. In the first case, where the air was extracted from the top, the result was good when the court was empty; in 12 minutes the air was entirely changed. But when the court was crowded the case was altered. The air very soon began to smell, even near the bench. In the other court, which was supplied with Tobin's tubes placed at the top, there was never a smell. The extraction of foul air from the floor was, in his opinion, the best plan.

Mr. Mackison (Dundee) added that he had been led to adopt a mixed system, combining the two principles. If he put in pure air, he was sure of obtaining an advantage, but if he extracted air, he might take out pure air with the impure.

Dr. Greene, in reply, said he agreed with Dr, Saunders as to the importance of a site which would afford the chance of a good water supply. In answer to Professor Banister Fletcher, he said double-sash windows were objectionable when blocks had to be used, but when the window itself was double there was no necessity to use blocks. The air-pipe referred to opened into the chimney at the base.

Mr. G. T. Hine, in replying, said two points which had been referred to ought to have a word in reply. When Mr. Mackison advocated wards with a western aspect rather than those facing the south, he probably had in mind a fever hospital. In building a hospital where the patients were always in bed, wind was a more necessary element than sun, but in lunatic asylums, sunshine was a necessity if a cure was to be effected. The patients would be up and about, and opportunities should be given for exercise at all hours of the day in the open air. In large buildings, such as the Claybury Asylum, they should be glad to get any outside aspect, east, south, or west, but if the principal front was to the south, they must have east or west as well. The other point had reference to the vexed question of how air ought to be admitted into a room. All depended upon the system adopted. If they trusted to nature, the proper point to extract from was the top of the room. He had studied the question for many years, and had made extensive experiments. When the question of inlet and outlet flues was first before him, he was as sceptical as a good many of those present. While building large board schools for 1,100 or 1,200 children, he had determined to try extraction from the top in one case, and extraction from the bottom in the other. He did not employ the Blackman fan, but something adapted to effect the same purpose. It was obvious that if mechanical power was employed to force air into a room, if the room were warmer than the surrounding atmosphere, the warm air would rise to the top of the room, and half of it might escape without mixing with the surrounding air, just as water might be forced through a lake, leaving the great mass of the water in the lake stagnant.

Sir Arthur Blomfield referred to a matter which had come before another Section, and which required to be dealt with at once. On the previous day a resolution had been proposed in the Section of State Hygiene which, in his opinion, more properly belonged to the Architectural Section. It was a question with regard to the education of architects. That section had passed a resolution in favour of the statutory examination and registration of architects. It appeared to him that such a resolution should have been at once referred to that Section.

Dr. Sykes then proposed the following *Resolution,* which was seconded by Mr. Ernest Turner, F.R.I.B.A., and supported by Mr. Rogers Field, C.E.:—

> "The members of the Architectural Section desire to consider the resolution adopted by the Section of State Hygiene approving of the statutory examination and registration of architects, before the definite adoption of the resolution by the Congress. They are of opinion that this question should have been referred to Section VI., 'Architecture in Relation to Hygiene.'"

The resolution was put, and carried unanimously.

INDEX.

A.

Page

President (Sir Arthur
l) - - - 7
ons for supply of fresh,
ght to dwelling rooms - 36
Professor), remarks on
rol of the construction
ng houses - - 39
), remarks on sanitation
es - - - 70
ts to Metropolitan Build-
1878 and 1890 - - 34
re in relation to hygiene.
ur W. Blomfield.) - 7
wellings, London County
regulations for - - 37
model byelaws regula-
ding of - - - 37
Parisian, principal causes
itary state of. (Émile
.) - - - 81
publique, action de l',
ux habitations ouvrières
nes - - - 84
arrangement and con-
of. (Richard Green.) - 139
gement of wards in - 147
fication of patients in - 147
ruction and arrangement
T. Hine.) - - 145
ng of apartments in - 148, 152
ion of administrative
ent in - - - 150
Councillor), remarks on
three storeyed tenements
people - - - 121
remarks on local isola-
pitals as opposed to a
hospital - - - 138
remarks on furnishing
rom central districts for
and power in towns and
- - - - 45
e, cause of hygrometric
in - - - 46
of mechanical change
- - - 46
ler Städte, hygienische
tze für die Erweiterung
inneren. (J. Stübben.) 17

B.

Page

Bakehouses Regulation Act, provisions of - - - - 89
——, workrooms, &c., insanitary condition of, in Paris. (F. Bouhon.) - - - - 88
Beckwith (H. L.), remarks on blocks of dwellings - - 118
Blair (Mr.), remarks on construction and arrangement of asylums 155
Blashill (Thomas), Control of the construction of dwelling-houses - 33
—— —— remarks on hygienische Grundsätze für die Erweiterung und den inneren Ausbau der Städte - - - - 31
—— —— remarks on two and three-storeyed tenements for the people - - - - 121
Block dwellings - - 103
Blomfield (Sir Arthur), on a resolution with regard to the education of architects - - 156
—— —— Presidential address - 7
—— —— remarks on some insanitary superstitions in house-building - - - 77
Bond (E.), remarks on two and three storeyed tenements for the people - - - - 117
—— —— remarks on the control of the construction of dwelling-houses - - - - 40
Bouhon (F.), remarks on sanitation of theatres - - - 71
—— —— The insanitary conditions of workrooms, bakehouses, &c., in Paris - - - 88
Browne (Lennox), remarks in reply to discussion on sanitation of theatres - - - 72
—— —— Sanitation of theatres - 66
Brydges (E. T.), remarks on the control of the construction of dwelling-houses - - - 42
Buchan (W. P.), remarks on paper sur la constitution hygiénique des murs d'habitation - 61
Buildings Act, Metropolitan, 1878 84, 88, 88

Page

Building, structural conditions of a habitable, necessary to health - 33
Burial Grounds Act, Disused, of 1884 - - - - 13
Burroughs (S. M.), On furnishing steam from central districts for heating and power in towns and cities - - - - 43
—— —— remarks on two and three storeyed tenements for the people - - - - 118
—— —— remarks in reply to discussion on furnishing steam from central districts for heating and power in towns and cities - 45

C.

Cacheux (Émile), Étude sur les principales causes d'insalubrité des habitations ouvrières parisiennes - - - - 81
Cameron (Spottiswoode), remarks on paper sur la constitution hygiénique des murs d'habitation - - - - 50
Casings, insanitary superstitions - 73
Chemin de fer, action des compagnies de, relative aux habitations ouvrières parisiennes - 84
Cistern, the, an insanitary superstition - - - 75
Closets, situation of, in theatres - 62
Collins (H. H.), remarks in discussion on paper sur la constitution hygiénique des murs d'habitation - - - 51
—— —— remarks in discussion on some insanitary superstitions in house-building - - - 76
—— —— remarks in discussion on two and three storeyed tenements for the people - - 119
—— —— remarks in discussion on open spaces - - - 16
—— —— remarks in discussion on the control of the construction of dwelling-houses - - 42
Curtains, an insanitary superstition - - - 74
Cuypers (P. J. H.), Sur l'emploie des fondations dur sur pilotis pour les habitations - - 51

D.

Page

Day (Alderman Ernest), remarks in discussion on local isolation hospitals as opposed to a central hospital - - - 138
Death-rate, cause of decrease in, in United Kingdom - - 12
Diagrams illustrative of the sanitation of theatres. (E. Turner.) - 65–69
Diseases calling for isolation - 124
Dolan (Dr.), remarks in discussion on sanitation of theatres - - 71
Drainage of soil that is naturally damp, model byelaws regulating 34
Drains, advantages of four-inch - 79
——, four-inch *versus* six-inch. (G. M. Lawford.) - - 78
——, objections to six-inch - 80
Dwelling houses, control of the construction of. (Thomas Blashill.) - - - 33
Dwellings, block, for the industrial classes. (John F. J. Sykes.) - 102

E.

Elliott (W. N.), remarks in discussion on the control of the construction of dwelling-houses - 42
Emden (Walter), remarks in discussion on sanitation of theatres 71
Épargne, action des caisses d', de Paris relative aux habitations ouvrières parisiennes - - 84
Erweiterung der Städte, hygienische Grundsätze für die. (J. Stübben.) - - - 17
—— und der innere Ausbau der Städte, allgemeine Aufgabe. (J. Stübben.) - - 17, 18
—— —— Amtliche Maassnahmen. (J. Stübben.) - - - 17, 24
—— —— Gesetzgebung. (J. Stübben.) - - - 18, 30
—— ——, hygienische Erfordernisse. (J. Stübben.) - - 17, 21

F.

Fenger (Professor), remarks on the presidential address - - 11
Few (Rev. C. E.), Local isolation hospitals as opposed to a central hospital - - - - 132
—— ——, remarks in reply to discussion on local isolation hospitals as opposed to a central hospital - - - 139

Page

Field (Rogers), remarks in discussion on paper on hygienische Grundsätze für die Erweiterung und den inneren Ausbau der Städte - - - - 31
—— ——, remarks in discussion on paper on open spaces - - 16
—— ——, remarks in discussion on construction and arrangement of asylums - - - - 154
Fire-watch at theatres - - 61
Fletcher (Banister), remarks in discussion on papers on construction and arrangement of asylums 154
Fosbrooke (Dr.), remarks in discussion on local isolation hospitals as opposed to a central hospital - - - 137

G.

Gardens, Metropolitan, Public, Association work of - - 13
——, public necessity for - - 22
Gely (André) - - 88
Godwin (E. W.), on dress in its relation to health and climate - 9
Gould (Engel R. L. remarks in discussion on open spaces - 16
Greene (Dr.), remarks in reply to discussion on construction and arrangement of asylums - - 156
——, The arrangement and construction of asylums - - 139
Grimshaw (Dr.) remarks in discussion on two and three storeyed tenements for the people - - 119
Ground-air, remarks on, by Edwin T. Hall - - - - 41
Gruber (Professor T. v.), remarks in discussion on paper sur la constitution hygiénique des murs d'habitation - - - 50

H.

Habitations à bon marché, hygiene des groupes d'. (Charles Lucas.) 32
—— à bon marché, la société française des - - - 87
——, l'emploie des fondations sur pilotis pour les. (P.J.H. Cuypers.) 51
—— ouvrières de Passy-Auteuil - 86
—— ouvrières parisiennes. (É. Cacheux.) - - - 81

Page

Hall (Edwin T.), remarks in discussion on the control of the construction of dwelling-houses - 41
Hannam (Councillor), remarks in discussion on some insanitary superstitions in house-building 77
—— —— remarks in discussion on two and three storeyed tenements for the people - - - 118
Health Acts, Public, Amendment Act, 1890, provisions of - - 114
——, Public, Act - - 33, 34, 95
——, Public, Amendment Act, with respect to building legislation - - - 42
Heathcote Hospital, Leamington, drainage and water supply - 131
—— ——, Leamington. (Keith D. Young.) - - - 127
—— ——, Leamington, Ward block - - - 130
Heating, advantages of system for furnishing steam from central districts for, in towns and cities - 44
—— in towns and cities, on furnishing steam from central districts for. (S. M. Burroughs.) - 43
Hine (G. T.), Construction and arrangement of asylums - - 145
—— ——, remarks in reply to discussion on construction and arrangement of asylums - - 156
Holly system of supplying steam to towns, &c. - - - 43, 44
Holmes (Mrs. Basil), On open spaces - - - 11
Homes, cottage, for the industrial classes. (R. Plumbe.) - - 96
Hooper (Mr.), remarks on block buildings - - - 118
Hospital, cost of a central - - 135
——, estimate of cost of portable - 136
Hospitals, English isolation. (R. Thorne Thorne.) - - 123
——, extent of provision to be made for isolation - - 124
——, isolation, allotment of bed-space - - - 126
——, ——, buildings - - 125
——, local isolation, as opposed to a central hospital. (C. E. Few.) 132
——, portable - - 133
——, site of isolation - - 125
Hospital, the Heathcote, Leamington. (Keith D. Young.) - - 127

Page

House-building, insanitary superstitions in. (H. H. Statham.) - 72
Houses, isolated, of two storeys only, the commercial possibility of, in London - - - 116
Hygiene, architecture in relation to. (Sir Arthur W. Blomfield.) - 7
Hygiène des groupes d'habitations à bon marché. (Charles Lucas.) 32

I.

Industrial classes, cottage homes for. (R. Plumbe.) - - 96
Industriels, action des, relative aux habitations ouvrières parisiennes - - - 84
Isolation, diseases calling for - 124

J.

Jeaffreson (Mr.), remarks in discussion on local isolation hospitals as opposed to a central hospital - - - - 137
Johnson (B.), remarks in discussion on open spaces - - 16
Jones (Rev. Harry), remarks in discussion on the control of the construction of dwelling-houses - 41

L.

Lawford (G. M.), Four-inch drains *versus* six-inch drains - - 78
Light, provisions for the supply of fresh air and, to dwelling rooms - 36
Lodging-houses Act, Common - 91
Lodging-houses, common, accommodation of - - - 94
—— ——, common, chief conditions under which allowed to be carried on - - - 93
—— ——, common, inspection of - 93
—— ——, common. (P. Gordon Smith.) - - - - 90
—— ——, common, separation of sexes in - - - - 96
—— ——, common, table showing extent to which the system prevails in certain provincial towns - - - 92
—— ——, common, ventilation of - 95
—— ——, warming of - - 95
London 30 years ago and to-day - 48
Longstaff (G. B.), remarks in discussion on the control of the construction of dwelling-houses - 39
Lucas (Charles), Hygiène des groupes d'habitations à bon marché - - - 32
—— ——, on presidential address - 11

M.

Mackison (W. M.), remarks in discussion on construction and arrangement of asylums - 155, 156
Manchester building byelaws, provisions of - - - 35
Meath, Earl of, paper on open spaces read by - - - 11
Metropolitan building byelaws, requirements of - - - 35
Mortality, average rate of, in London - - - - 81
—— average rate of, in Paris - 81
Murs d'habitation, sur la constitution hygiénique des (Émile Trélat.) - - - - 45

N.

Nasmyth (Dr.), remarks in discussion on local isolation hospitals as opposed to a central hospital - - - - 137
Nevill (Ralph), remarks in discussion on paper sur la constitution hygiénique des murs d'habitation - - - 50
—— —— remarks in discussion on some insanitary superstitions in house-building - - - 76
—— ——, —— on two and three-storeyed tenements for the people 117
Newsholme (Dr.), on the vital statistics of block dwellings - 112
Noel Park, account of estate of - 98

O.

Open Spaces Acts of 1877, 1881, 1887, and 1890 - - - 13

P.

Pain (Coard S.), remarks in discussion on the control of the construction of dwelling-houses - 39
"Pavilion" principle in building asylums - - - - 146

Page

Philanthropie, action de la, relative aux habitations ouvrières parisiennes - - - 85
Pilotis, l'emploie des fondations sur, pour les habitations. (P. J. H Cuypers.) - - 51
Plumbe (Rowland), Cottage homes for the industrial classes - - 96
—— —— remarks in discussion on two and three storeyed tenements for the people - - 122
Population, annual increase of, in large European towns - - 19
Powers Act, the London Council, General, provisions of - 35
Prendergast (Colonel), remarks in discussion on some insanitary superstitions in house-building - 76
Presidential address. (Sir Arthur W. Blomfield.) - - - 7

R.

Rawlinson (Sir Robert), remarks in discussion on construction and arrangement of asylums - - 155
Refuse, requirements of the model byelaws for the removal of, from houses - - - - 37
—— structural measures necessary for the removal of, from houses 37
Richardson (Dr. B. W.), on sanitary reform in relation to the fine arts - - - - 10
Robinson (R. A.), remarks in discussion on furnishing steam from central districts for heating and power in towns and cities - 45
Ross (J. Maxwell), remarks in discussion on local isolation hospitals as opposed to a central hospital - - - - 138

S.

Saunders (Dr.), remarks in discussion on construction and arrangement of asylums - - 155
Seddon (Col.), remarks in discussion on some insanitary superstitions in house-building 77
Seddon (J. P.) remarks in discussion on H. H. Statham's paper on some insanitary superstitions in house-building - - 76

Page

Seddon (J. P.), remarks in discussion on two and three storeyed tenements for the people - 118
"Skirtings," an insanitary superstition - - - - 73
Slater (John), remarks in discussion on hygienische Grundsätze für die Erweiterung und den inneren Ausbau der Städte - - - - 31
Smith (P. Gordon), Common lodging houses - - - 90
—— —— remarks in discussion on two and three-storeyed tenements for the people - - 121
Smith (Noble), remarks in discussion on two and three-storeyed tenements for the people 117
Smith (Wilberforce), remarks in discussion on some insanitary superstitions in house-building - 77
Sociétés Savantes, action des, relative aux habitations ouvrières parisiennes - - - 84
Spaces, model byelaws regulating size of open - - - 36
—— measures for securing open - 13
—— open. (Mrs. Basil Holmes.) 11
Speculation, action de la, relative aux habitations ouvrières parisiennes - - - 84
Städte, hygienische Grundsätze für die Erweiterung und den inneren Ausbau der. (J. Stübben. - 17
Statham (H. H.), remarks in discussion on hygiene des groupes d'habitations à bon marché 32
—— —— remarks in discussion on paper sur la constitution hygiénique des murs d'habitation - - - - 51
—— —— remarks in discussion on construction and arrangement of asylums - - - - 155
—— —— remarks in discussion on the control of the construction of dwelling-houses - - - 41
—— —— in reply to discussion on some insanitary superstitions in house-building - - - 78
—— —— Some insanitary superstitions in house building - 72
Steam power, furnishing of, from central districts for heating in towns and cities. (S. M. Burroughs.) - - - 43

Page

Stübben (J.), Hygienische Grundsätze für die Erweiterung und den inneren Ausbau der Städte - 17
Suburban villages - - - 104
Sykes (Dr.), remarks in discussion on two and three storeyed tenements for the people - - 123
—— —— remarks in discussion on the control of the construction of dwelling-houses - - 42
—— —— resolution referring to education of architects - - 156
—— —— Block dwellings for the industrial classes - - - 102
—— —— remarks in discussion on open spaces - - - 16

T.

Techner (Ludwig), remarks in discussion on hygienische Grundsätze für die Erweiterung und den inneren Ausbau der Städte - 31
Tenement houses - - - 103
Tenements, two and three-storeyed, for the people. (Locke Worthington.) - - - 114
Theatres, accommodation of - - 61
—— closets in - - - 62
—— Diagrams illustrative of the sanitation of. (Ernest Turner.)- 64
—— heating of - - - 64
—— lighting of - - - 63
—— Sanitation of. (Lennox Browne.) - - - 56
—— situation of - - - 59
Thorne Thorne (R.), English isolation hospitals - - 123
—— —— remarks in discussion on local isolation hospitals as opposed to a central hospital - 139
Trélat (Émile), remarks in reply - 51
—— —— Sur la constitution hygiénique des murs d'habitation - - - - 45
Turner (Ernest), Diagrams illustrative of the sanitation of theatres - 64

V.

Village, model cottage, description of - - - - 97

W.

Wakefield (T. F.), remarks in discussion on local isolation hospitals as opposed to a central hospital - - - - 137
Walls, ability of, to protect interiors from atmospheric changes - - 46
—— influence of, on the indoor atmosphere - - - 48
Water and light, necessity for supply of - - - 23
White (Wm.), remarks in discussion on paper on hygiène des groupes d'habitations à bon marché - - - - 32
Workrooms, insanitary condition of, in Paris. (F. Bouhon.) - 88
Worthington (Locke), Two and three-storeyed tenements for the people - - - - 114

Y.

Young (Keith D.), The Heathcote Hospital, Leamington - - 127

LONDON: Printed by EYRE and SPOTTISWOODE,
Printers to the Queen's most Excellent Majesty.

TRANSACTIONS

OF THE

Seventh International Congress of Hygiene and Demography.

LONDON, AUGUST 10TH–17TH, 1891.

Patron:—HER MAJESTY THE QUEEN.

President:—H.R.H. THE PRINCE OF WALES, K.G.

VOLUME VII.

SECTION VII.

ENGINEERING IN RELATION TO HYGIENE.

EDITED BY C. E. SHELLY, M.A., M.D.,
Assisted by the HONORARY SECRETARIES of the SECTION.

LONDON:
PRINTED BY EYRE AND SPOTTISWOODE,
PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY.

1892.

- 16863 -

ASTOR LIBRARY
JUN
6
1893
NEW YORK

OFFICERS OF THE SECTION.

PRESIDENT.

SIR JOHN COODE, K.C.M.G., Past President of the Institution of Civil Engineers.

HONORARY PRESIDENTS.

G. BECHMANN, Ingenieur en chef du service de l'Assainissement, Professeur à l'Ecole Nationale des Ponts et Chaussées, Paris.

FRANZ RITTER VON GRUBER, k. k. Hofrath Professor am höh Genie Curse, Mitglied des obersten Sanitatsrathes, Vienna.

R. HENNEBERG, Civil Ingenieur, Berlin.

Prof. H. PACCHIOTTI, Senateur, Turin.

VICE-PRESIDENTS.

SIR ROBERT RAWLINSON, K.C.B., Vice-President of the Institution of Civil Engineers.

THOMAS HAWKSLEY, F.R.S., Past President of the Institution of Civil Engineers.

JAMES MANSERGH, Memb. of Council of the Inst. C.E.

Major HECTOR TULLOCH, R.E., Chief Engineering Inspector to the Local Government Board.

ALEX. R. BINNIE, Memb. Inst. C.E., Engineer-in-Chief, London County Council.

H. PERCY BOULNOIS, Memb. Inst. C.E., Past President of the Association of Municipal and County Engineers, City Engineer, Liverpool.

JAMES M. GALE, Memb. Inst. C.E., Glasgow.

Lieut.-Colonel HAYWOOD, Memb. Inst. C.E., Engineer to the Commissioners of Sewers of the City of London.

Professor HENRY ROBINSON, Memb. Inst. C.E., Professor of Civil Engineering at King's College, London.

HONORARY VICE-PRESIDENTS.

C. AMBT, Chief Engineer of the City of Copenhagen.

L. DE CSATÁRY, Chief Surgeon of the Hungarian Government Railway, Buda-Pesth.

A. HEGENER, General-Director Machinenbau, Anstalt Humbolt Kalk, Köln.

C. HERSCHER, Vice-President de la Société des Ingenieurs Civils, Paris.

A. HERZBERG, Civil Ingenieur und Fabrikbesitzer, Berlin.

A. MAULT, Engineering Inspector to the Government Board of Health, Tasmania.

G. VAN OVERBECK DE MEYER, Professor of Hygiene in the State University, Utrecht.

L. PAGLIANI, Direttore Della Sanita Pubblica del Regno, Ministero dell Interno, Rome.

FRIEDRICH RITTER VON STACH, K. K. Baurath, Civil Ingenieur, Vienna.

M. SIJMONS, Civil Ingenieur, Rotterdam.

A. THIEM, Civil Ingenieur, Leipzig.

ÉMILE TRÉLAT, Professeur au Conservatoire national des Arts et Métiers, Directeur de l'Ecole d'Architecture, Paris.

COUNCILLORS.

JOSIAH CORBETT BRETLAND, Memb. Inst. C.E., City Surveyor, Belfast.

ARTHUR BROWN, Memb. Inst. C.E., Borough Engineer, Nottingham.

JOHN HENRY COX, Memb. Inst. C.E., Borough Surveyor, Bradford.

SPENCER HARTY, Memb. Inst. C.E., Ireland (Past Pres.), City Engineer, Dublin.

Thomas Hewson, Memb. Inst. C.E., Borough and Waterworks Engineer, Leeds.

Arthur Jacob, B.A., Memb. Inst. C.E., Borough Engineer, Salford.

William George Laws, Memb. Inst. C.E., City Engineer, Newcastle on-Tyne.

A. B. M'Donald, Memb. Inst. C.E., City Engineer, Glasgow.

William Mackison, F.R.I.B.A., City Engineer, Dundee.

Alfred Edward White, Borough Engineer, Hull.

Charles Frosgatt Wike, Memb. Inst. C.E., Borough Surveyor, Sheffield.

HONORARY COUNCILLORS.

A. Bonna, Secrétaire Général de la Cie. des Eaux l'Etranger et de la Cie. Générale des Eaux Vannes, Paris.

L. Bouniol, Ingenieur des Arts et Manufactures, Paris.

G. Earl Church, M. Am. Soc. C.E., 9, New Broad Street, E.C.

Carl Juhlin-Dannfelt, Consul-General for Sweden and Norway.

E. A. Delcomyn, Consul-General for Denmark.

Emin Effendi, Consul-General for Turkey.

G. M. Gariel, Ingenieur en chef des Ponts et Chaussées, Paris.

L. Gensis, Administration, Directeur-Général, Société Parisienne d'Entreprises Générales de Travaux, Paris.

L. Hudelo, Repetiteur a l'Ecole Centrale, Paris.

Chevalier F. Krapf de Liverhöff, Assistant Consul-General for Austro-Hungary.

W. Kümmel, Director der Gas und Wasser-Gesellschaft, Altona.

Louis Lechner, Conseiller Ministeriel, Directeur des Travaux Publics de la Ville de Buda-Pesth.

M. Linder, Inspecteur-Général des Mines, Paris.

Jonkheer J. W. May, Consul-General for the Netherlands.

J. F. Meyer, Chief of the Department of Streets and Sewers, Copenhagen.

Dr. Franz Migerka, Chief Inspector of Factories and Workshops for Austria, Vienna.

L. Mitgau, Stadtischer Oberingenieur, Braunschweig.

Don M. Montejo, Consul-General for Spain.

J. Piet, Membre du Jury, Exposition Universelle, 1889, Paris.

Manoel da Silva Pontes, Consul-General for the United States of Brazil.

HONORARY SECRETARIES.

Reginald E. Middleton, Memb. Inst. C.E.

H. C. Houndle, Local Government Board, S.W.

TABLE OF CONTENTS.

	Page.
Presidential Address	7
Sewage Disposal with reference to River Pollution and Water Supply	11
L'Assainissement des Villes en Italie	17
Sanitation in India	18
French and English Systems of Sewerage	24
The Removal of Sewage after leaving Buildings	27
The Sanitation of a Mining Settlement	31
Discussion	34
Sewer Ventilation	45
Sewer and Drain Ventilation	47
The better Ventilation of Town Sewers	52
Discussion	58
Assainissement des Villes: Traitement des Eaux d'Égout par les Procedés Agricoles	65
On the Application of an Intercepting Reservoir (of the type of Mouras's fosse) and of a Peat Filter for Sewage, to the Separate System of Sewerage	74
Les Procédés d'Assainissement des Villes	84
The Wolverhampton Sewerage Works	89
Die Kanalisation der Stadt Berlin	91
Water Supply	100
De la Distribution dans les Villes de deux eaux de qualité différente par des Canalisations distinctes	102
The Separate Water Supply for Domestic and for Sanitary Purposes at Southampton	108
Discussion	111
L'Hygiène des Chemins de Fer et des Voyageurs	119
The Revolving Purifier for treatment of potable waters by means of metallic Iron	129
The Purification of Water by Rapid Filtration	133
Über die Wirkung der Electricität auf die suspendirten und gelösten Stoffe der Abwasser	138
The Water Supply of Maritime Towns	140
On Maps showing the Area of Chalk available for Water-supply in the Central and Eastern parts of the London Basin	144
The Influence of Ground Water upon Health	145
Drainage and Irrigation of Land in their Relation to Health	149
Discussion	155
Projets pour l'alimentation en eau potable d'une grande parte de la France au moyen de l'eau des lais de Neuchatel et du Léman	160
Eindringen von Unreinigkeiten in Druckwasserleitungen	167
The present state of our knowledge concerning the Self-purification of Rivers	170
Abkühlung des Wassers durch Anlage von Kühlschächten	175
Discussion	180

Page

The Refuse Destructor - - - - - - - - 188

On the Cleansing of the Streets and the Removal of Household Refuse in German Towns - - - - - - - - 203

Experiments in the Burning of House Refuse - - - - 205

Refuse Burning - - - - - - - - 210

How best to dispose of the Refuse of large Towns - - - 218

Discussion - - - - - - - - 219

Municipal Engineering - - - - - - - - 223

Discussion - - - - - - - - 227

Die Typhus-Epidemie in Altona 1891 und das filtrirte Flusswasser - - 229

The Water Supply of India - - - - - - - 242

Discussion - - - - - - - - 250

Aperçus sur l'Assainissement du Sous-sol des Villes - - - 252

Discussion - - - - - - - - 260

INDEX.

SECTION VII.

ENGINEERING IN RELATION TO HYGIENE.

Tuesday, 11th August, 1891.

The Chair was occupied successively by
The President, Sir JOHN COODE, K.C.M.G., and
Professor HENRY ROBINSON, M.I.C.E.

PRESIDENTIAL ADDRESS

BY

Sir JOHN COODE, K.C.M.G., Past President of the Institution of Civil Engineers.

It is my first duty, and I esteem it at the same time to be my great privilege, to offer, as I now do, on behalf of the English members of the Engineering Section, a cordial welcome to those brethren of our profession who have come among us from afar in order to be present at this Seventh International Congress of Hygiene and Demography.

It has been, I can assure you, the anxious desire of the Organising Committee to provide such papers as will contribute to the advancement of the knowledge of hygiene in all its branches.

Of both the scope and the importance of the subject with which the Congress has taken upon itself to deal, there cannot surely be two opinions. Having for its principal—or rather it may be said for its sole—aim and object, the preservation of health (or in other words the *prevention* rather than the *cure* of disease) the subject of hygiene may well occupy the attention, and claim the interest, of all who desire the welfare of the human race.

As we, the British members, are well assured, it is because the object of this gathering is one which is in an especial degree calculated to benefit the community at large, that it enjoys the patronage of our honoured and beloved Sovereign Queen Victoria, and that it is supported by the Presidency of the Prince of Wales; by his presence at our opening meeting yesterday His Royal Highness has given personal proof that he feels a genuine interest in the success of the cause which we all have at heart.

It will not, it is to be hoped, be devoid of interest, if I here offer a few remarks on the progress of modern legislation in this country in respect of sanitary matters.

About the year 1838 the public mind of Great Britain became first aroused, so to speak, to the serious and growing evils arising from the absence of proper precautions for the preservation of the health of the dwellers in our large towns and cities generally, and more especially in this Metropolis in which we are now assembled.

Between 1838 and 1848, the question of Public Health in the United Kingdom was dealt with in the course of frequent debates and discussions in Parliament; it also formed the subject of inquiries by Committees and Commissions. At the end of that decade these investigations and discussions culminated in the establishment of an entirely new Department, which was entitled the "General Board of Health"; ten years later on, that body was superseded by an Act of the Legislature, under which the important Department known as the "Local Government Board" was created.

Many names might be mentioned in connexion with the work of the two decades just adverted to, but amongst them there stands out most prominently that of one man, the late Sir Edwin Chadwick, whose untiring zeal and well-directed labours contributed more than those of any other single individual to the success of this great movement, and to the adoption of those important measures which have conduced in so great a degree to the improvement of public health in this country.

When speaking to a body of civil engineers, as I have now the honour of doing, it would be remiss to omit to mention the name of another gentleman, whom we have the privilege of including in our list of Vice-Presidents; I refer, of course, to Sir Robert Rawlinson; his eminent services, first in the organisation, and, secondly, in the direction for many years, of the Engineering Department of the Local Government Board, have deservedly received the marked approval of the Sovereign.

The importance of a correct knowledge of the laws of hygiene being granted, this importance becomes accentuated in every place where human beings are congregated together in considerable numbers, as in the case of large towns and cities, the greatest and most notable example of which is this mighty Metropolis, this "City of immensity," as it has well been called. Is there not therefore a peculiar fitness in the holding of this Hygienic Congress in London, which contains the greatest congregation of human beings the world has even seen?

Permit me to mention a fact or two which may serve to give some of those whom I now address a more exact idea of the magnitude of this London of ours.

The population of the metropolis is, in round figures, 5,660,000. The vastness of this number will perhaps be somewhat better realised by my stating the fact that it is considerably greater than the numbers of the inhabitants of the cities of Paris, of Berlin, of Vienna, and of Rome, all combined.

As a matter which cannot fail to be of special interest to engineers, let us turn for a moment and see what has been done in the way of works that have been executed for the special purpose of improving the health of London.

The main intercepting and principal branch sewers which have been constructed for the conveyance of the sewage of London to the two outfalls into the River Thames, at Barking and Crossness respectively, measure about 80 English miles, equal to 130 kilometres.

Since the year 1856, when the now extinct "Metropolitan Board of Works" was formed, there has been expended on the main drainage works alone the sum of nearly 6,000,000*l.* [120,000,000 marks or 150,000,000 francs].

As a by no means unimportant factor among the changes which, in modern times, have resulted in the better health of our capital city, a reference to the supply of water of improved quality, and in larger quantity, must not be altogether omitted. Up to the end of 1890 the several companies (eight in number) had expended upon works for the supply of water to London, a sum very closely approximating to 15,000,000*l.* [300,000,000 marks or 375,000,000 francs].

The average quantity of water delivered last year to the inhabitants of London, for domestic purposes alone, was 24·75 gallons per head of population per diem, and in point of quality but little, if at all, surpassed by that supplied to any other city in Europe; this water is conveyed through pipes, the united length of which is about 4,760 miles. The total volume of water delivered for domestic purposes only in 1890 was 64,000,000,000 gallons [290,623,000 cubic metres]. For raising this large quantity the companies employed no less than 184 steam pumping engines, having an aggregate of 21,659 horse-power. I may here make a passing remark with regard to this large quantity, upwards of 21,000 horse power. As you all know, six hours a day of continuous work is good work for a horse; therefore in that view this quantity might be multiplied by four, making it 80,000 horse power. That is not quite correct, because during the night these pumping engines slow down to some extent; but you may multiply the 21,000 by three. Supposing you were to employ animals to do that amount of work you would require over 60,000 horses to pump the water daily required for London; that it is from two-and-a-half to three times the number of horses in the entire British Army, both at home and abroad. Taking that fact into consideration, it will assist in giving some idea of the labour involved in supplying water alone to this great city of ours.

As another illustration of the magnitude of London it may be mentioned that the streets and roads within the Metropolis, if placed end to end in one continuous line, would measure about 2,500 miles, equal to the distance from London to Land's End, and thence across the Atlantic Ocean to the mouth of the Gulf of St. Lawrence in Canada on the west, or, going eastward, would extend across the entire Continent of Europe, and beyond the Ural Mountains into Asia.

Whilst admitting that extensive drainage works have been executed, and that large expenditure has been incurred for improving the health of London, it cannot yet, by any means, be said that all has been done which might be done in this direction. Nor will it be possible to say as much as long as the sewage of the Metropolis is allowed to flow into any part of the Thames without previous purification by the most perfect method as yet known, *i.e.*, by being filtered through land. The only alternative would seem to be the conveyance of the sewage to the sea coast beyond the mouth of the estuary of the Thames.

Nevertheless, and notwithstanding the room which exists for further improvement in the disposal of its sewage, the reduction which has been brought about in the death-rate of London in modern times is as noteworthy as it is satisfactory. A few facts will show the benefits that have accrued from the better understanding, and the more effectual application, of the laws of hygiene in our Metropolis.

In the latter half of the 17th Century the average mortality of London is said to have been not less than 80 per 1,000; at the end of the 18th Century it had dropped to 50 per 1,000; in the decade ending in 1850 it was 25 per 1,000; in that ending in 1870 it was 24·0 per 1,000; whilst in that ending in 1890 it had further fallen to 19·8 per 1,000.

It is gratifying to note that for the year 1889, taken *per se*, the rate was as low as 17·4 per 1,000, and there is no reason for supposing that it would not have been equally low for the year 1890, had it not been for the unfortunate epidemic which then prevailed, in consequence of which it rose in 1890 to the same proportion as that at which it stood in the early part of the last decade, viz., 20·3 per 1,000.

In the opening part of this address it was stated that it had been the anxious desire of the Organising Committee to provide on this occasion such papers as would contribute to a further knowledge of the subject of hygiene; I will now only add, in conclusion, that as far as regards our own particular section, we, speaking on behalf of the Engineering Committee, have, in this respect, endeavoured to fulfil our part, and have also made arrangements for your inspection of works of professional interest from a hygienic point of view.

We trust that the papers to be read and discussed, and the visits which have been organised, will prove to be not altogether uninstructive, and that they will result, in some degree at least, in furthering the aim and object of this International Congress, *i.e.*, the advancement and diffusion of sound and useful knowledge relating to the all-important subject of sanitary science.

Sewage Disposal with Reference to River Pollution and Water Supply.

BY

Professor HENRY ROBINSON, M. Inst. C.E., F.G.S., F.R.M.S.

Too great stress cannot be laid on the necessity for effectually and promptly removing the excremental and other refuse from the midst of the communities producing them. In an International Congress it may be desirable, however, to say that great care is required not to apply indiscriminately the systems which have been found suitable to this country or to western habits. It is very doubtful whether to centres of population in eastern countries, the water-closet system is applicable; in many cases it is quite unsuitable. The traditions, climate, habits, or religious prejudices of oriental races render impossible the application of systems which have been successfully adopted in the west. The wide diversities of race in the centres of populations under British rule call for special care in providing appropriate remedies for the terribly insanitary state in which vast numbers of our fellow subjects now live, and in avoiding the mistake of applying remedies which may prove to be worse than the evils they are intended to remove.

It is of the utmost importance that the sewerage of towns in the future should be carried out in the light of the experience that has been gained in the past, and that the sewers should be designed to remove, and not retain, the foul matters that are delivered into them. It is considered to be impossible to accomplish this if the sewers are made of a size to carry off the bulk of the rainfall. During long periods of dry weather, the sewers retain much of the solid matter, which deposits, decomposes, and evolves unhealthy and filthy smells. This was recently experienced in many parts of the metropolis after the late winter drought. The existence of such a state of things in hot climates would be disastrous to health. Relief sewers to meet the conditions that occur during heavy rainfall it is thought should be more relied upon than is now the case, so as to enable the sizes of the sewers to be made sufficient for sewage proper, and to avoid their being sewers of deposit, which they too often are. Sewers ought to be self-cleansing, and the sewage which is removed by them ought to be brought to the point of discharge in a fresher state than is possible where the sewers are calculated to convey the bulk of the rainfall with the sewage. They then inevitably become sewers of deposit in dry weather, and give off dangerous gases. The first heavy rains flush the sewers, and carry the highly decomposed matter to the outfalls, increasing the difficulties of dealing with it; and if it is discharged into rivers, a destructive effect on fish life is produced.

The discharge of sewage or manufacturing refuse into streams to avoid the expense of previously treating it must be protested against. The rivers must no longer be regarded as the natural vehicle for removing it. What was at first an evil of comparatively small extent

has, with the rapid sewering of towns, became one of great magnitude. Public opinion is favourable to the adoption of drastic measures. The Rivers Pollution Prevention Act of 1876, requires amendment, so that it is mandatory instead of permissive. There is no justification for delay, inasmuch as even in 1872 it was stated (in the Fourth Report of the Second Commission), that "methods have been "described in our Reports involving no excessive expenditure, by which "the foulest liquid waste from manufactories can be adequately "cleansed. We believe that the adoption of none of them will inflict "any injury at all upon manufacturers; indeed, we have every reason "to conclude that their adoption will save the manufacturers of this "country from inflicting considerable injury upon themselves, whilst by "preserving the whole course of rivers in a comparatively clean and "useful condition they will tend powerfully to the extension of "manufactories upon their banks. One of the most crying evils in "manufacturing districts is the want of clean water, and therefore "every successful effort to make dirty water again usable is a gain to "manufacturers."

Standards of purity should be arrived at so as to enable the conditions which exist at any place to be fairly considered and dealt with. It would be inequitable were expensive works for purifying town or manufacturing refuse to be insisted on where the point of discharge enables it to be quickly carried seaward, or is remote from sources of supply of drinking water. The necessity for such standards is obvious, and is well recognised. Mention should be made in this connexion of the intelligent action that has been taken by which standards of purity for all liquids discharged into the River Spree have for years been in operation owing to the pollution which arose from the sewage of Zurich being passed into that river.

The discharge of the waste products of human life into rivers used for domestic water-supply must be attended with more or less danger, inasmuch as they will probably always contain a proportion of the germs of the various diseases which are capable of being disseminated and propagated in water.

The action that has been taken by the State Board of Health of Massachusets to protect the purity of inland waters deserves to be specially commended as an example of broad and wise policy in instituting the systematic investigations by engineers, chemists, and biologists of all that bears upon the purification of sewage, and on the filtration of water. By an Act of this State examinations are made of all waters for the purpose of ascertaining whether they are adapted for domestic supply, or are in a condition likely to impair the interests of the public or to imperil public health. The exhaustive reports under these different heads may be fairly stated to be far in advance of anything that has been attempted in this country.

The history and condition of a river into which sewage is discharged requires to be studied from several points of view, as conclusions arrived at in regard to one river may be totally inapplicable to another.

A very remarkable investigation was made at the beginning of this year by Professor Von Pettenkofer with reference to the sewage pollution of the river Isar between Munich and Threising when the river was at the lowest level from the long drought of last winter, and consequently when the proportion of fœcal matter to volume was at its maximum. The relative volumes of this river were 50 cubic metres per second during this dry period compared to 350 cubic metres per second during a previous flood time. A comparison was made between the amount of oxygen that was required to destroy the organic substances in the water at the time of minimum flow, and the amount that was required in previous periods of flood, and the observations of Professor Von Pettenkofer led him to the singular conclusion that no evil results followed the discharge of raw sewage into the river, and he undertakes to prove that bacteriological investigations do not support the view that injury is done to this river by sewage being discharged into it.

The chief characteristics of fresh sewage are free ammonia (or decomposition in progress) and chlorine. When sewage is discharged into a river it becomes diluted, and the ammonia is reduced by oxidation and through absorption by plant life. If it were not for the natural purification which rivers are capable of, the constant discharge of polluting matter into them would have made the evil cumulative. Fortunately the innumerable organisms which exist in rivers and which thrive on organic matter act as scavengers. They are aided by minute plants, which, under the influence of light, liberate oxygen and help to oxygenate the water.

It has been ascertained that entomostraca consume dead animal matter, and that where this is wanting they do not live, but where it is in abundance they thrive. It follows, then, that these minute animals exercise an important function in absorbing sewage impurities. They multiply prodigiously in these impurities, and are both created by them and fed upon them, converting foul and dangerous matters into harmless ones, in a similar way to that which is referred to hereafter as nitrification when speaking of the action of bacteria in the soil.

In a sluggish river pollution is less capable of being naturally removed than in rivers with falls, rapids, and swift currents. Some observers attribute the self purifying action of rivers more to the natural action of deposition, bacteria, and plant life than to any chemical influence of oxygen.

To new countries whose rivers are now free from pollution but where centres of population are springing up a warning should be given to avoid the evil results that older countries are now suffering from. Efforts are being made to divert sewage from the river Seine, and nine main sewers which used to discharge into the Siene at the island of St. Louis have been diverted by a syphon under the river, and this grave cause of pollution has been removed. The river Thames will soon be no longer the recipient of the crude sewage of London which has for so many years been a subject of strife. It is now admitted (after long and costly inquiries) that the outfalls at Barking and Crossness must be adapted to the clarification of the sewage, and the London County

Council, under the advice of their able chief engineer Mr. Alex. R. Binnie, C.E., and the intelligent supervision of his colleague Mr. Santo Crimp, C.E., are now adapting the Crossness Outfall Works to chemical treatment as was done at the Barking Outfall by the late Sir Joseph Bazalgette, the chief engineer of the Metropolitan Board of Works (the predecessors of the London County Council).

A clause was inserted in the Local Government Act, 1888, enabling county councils to deal with river pollution, and it is to be hoped that some good will result. An effort has been made by the authorities of Chester, Lancaster, Derby, and others interested in the river Irwell (notorious for its foul condition), by which the Rivers Pollution Prevention Act of 1876 could be put in force by the granting of a Provisional Order conferring powers on them. An application was made at the end of 1890 for such powers, and this forms an important precedent which will probably be followed up throughout the country. Objections were raised to such joint action on the ground of interference with the existing powers of the several local authorities who have ostensible control, and that such concurrent jurisdiction would create difficulties.

Where land is obtainable in sufficient areas, and of a porous nature, the fertilising properties of sewage can best be utilised on it, both from an agricultural and a sanitary standpoint. This is seldom possible, and where attempts have been made to purify sewage on unsuitable soils, commercial and sanitary failure have resulted. Experience has proved that where clayey or impervious lands have been deep-drained so as to ensure the passage of sewage through it, the result has been that the sewage has passed into the subsoil drains only partially clarified, and in a recent case the deep drains have had to be done away with, and the land used for broad irrigation. Twenty years ago the application of sewage to land was advocated under all circumstances, but experience has shown that the result of applying more than a very limited amount of sewage to non-porous soils is that it is not purified, and that sanitary mischief arises. The sewage may be to some extent mechanically strained, but the absence of the necessary free oxygen in the pervious soil prevents purification. When sewage irrigation or filtration is carried on without care and without the knowledge of the chemical and biological laws which require to be considered, there is a risk of pollution to subsoil waters and streams into which the sewage effluent passes. If an area of porous land can be obtained sufficiently large to enable the sewage of about 100 persons to the acre to be applied intermittently, then good agricultural results will ensue. Where sandy soils exist, as at the Craigentinny meadows near Edinburgh, or at Gennevilliers, where part of the sewage of Paris is treated, then large volumes can be applied with advantage to vegetation, and enormous crops can be produced. These are adduced as conclusive proof that sewage ought to be applied to land. Hungry soils of the nature referred to will no doubt pass immense volumes through them, and the crops will retain and assimilate that which they require to the great advantage of the agriculturist. If, however, the subsoil waters

were examined, insanitary conditions would be disclosed which should point to the necessity of taking a broader view of the subject than has too often been the case when irrigation enthusiasts have had their own way.

Mr. Robert Warington, in his experiments at Rothampstead, long ago established the fact that micro-organisms perform an important function in sewage filtration, and that the action of an earth-filter is not mechanical, but partly chemical and partly biological. The destruction of the organic impurities in sewage was shown to be brought about by a process of active fermentation or decomposition (termed nitrification) caused by bacteria. A question of great practical importance in connexion with both sewage disposal and water supply is whether any of these organisms can escape destruction. The conclusion that is arrived at by the American investigators in the before-mentioned Report of the State Board of Health, Massachusets, is that the belief that bacteria cannot survive to pass through sand-filters is fallacious, although the great bulk are destroyed. It follows from what has been said that in the disposal of sewage upon land or in filtering impure water, the necessity arises for exercising great care. Experiments upon sewage filtration have been made by Mr. Hiram Mills, C.E., of the Lawrence Experimental Station in America, which confirm the view that nitrification ceases if the filtration is not conducted intermittently. Also that sewage effluents that have been passed through sand-filters covered with soil, in which nitrification took place, resulted in the destruction of bacteria, and that the effluents from such filters were not favourable to the support of bacteria. This is due to the fact that the free and albumenoid ammonias in such effluents, being the residue of a much larger amount that has been destroyed, are much less able to support bacterial life than fresh organic substances containing the same amount of free and albumenoid ammonia.

Dr. Sedgwick, of the Lawrence Station, experimented specially to ascertain whether bacterial organisms could live to pass through 5 feet of coarse sand filters, worked intermittently. He found that they could, especially the bacillus prodigiosus, which appears to be a tolerably hardy specimen. It may be taken as proved that although the large bulk of organisms are destroyed by efficient filtration, nevertheless, some do pass when the filters are composed of sand alone. When the filters were of fine sand, but were covered with soil, the bacteria appeared to be all nitrified, and the effluent, even from sewage, was harmless, and might be drunk. The practical question is, are sources of water supply that require filtration to be condemned? The answer appears to be that, where possible, such sources of supply should be avoided, as circumstances might arise to cause some disease-producing bacteria to exist in the water, and as they are capable of increasing with enormous rapidity under favourable conditions, it would be unwise to disregard the possible mischief that might follow. With filters, however, properly constructed and manipulated, the mischief is avoidable. The data which are now available clearly indicate to engineers that the efficacy of the ordinary sand filter can be increased greatly by covering it with a soil suitable to developing the nitrifying action in the filter.

Chemical precipitation of sewage is now very frequently resorted to for the purpose of destroying the noxious properties in sewage. The hopes, however, of the first workers in this field of invention of doing this profitably have long since disappeared. The sanitary and commercial aspects of the matter have to be kept in view, and the experience that has accumulated enables simple chemicals alone to be adopted. These are able to effect sewage purification by themselves, where the highest standard of effluent is not required, or can be supplemented by subsequently passing the effluent through filters. Crude sulphate of alumina, proto-sulphate of iron (or copperas, the waste products of tin-works), are chemicals easily obtainable and are most usually employed to produce precipitation. A small amount of lime is used as an alkali, care being taken not to have an excess of lime if the effluent is to discharge into a stream where the secondary decomposition resulting from a lime effluent would be objectionable. If a high standard is necessary it is usual to pass the effluent through a small area of filter specially prepared, so that it effects the changes referred to elsewhere when speaking of nitrification. An artificially prepared material called polarite has attracted much attention recently. This is an insoluble, porous, and magnetic material, used by the International Sewage and Water Purification Company, which appears to have the property of destroying organic impurities in fluids in a remarkable manner. Dr. Anderson, C.E., has lately introduced the use of scrap-iron in a revolving cylinder as a medium through which impure water can be passed and purified.

The sludge deposited from any process of chemical treatment has a very doubtful value for agricultural purposes. That known as the A.B.C. process (where alum, blood, and clay are the precipitants) claims to have a higher value than chemists assign to it; and, as recent researches show how much has yet to be learnt about the changes that take place in the soil, the simple test of agricultural results appears a fair one if applied commercially. At the Metropolitan Outfall Works at Barking the sewage is treated by the addition of milk of lime in the outfall sewer, then proto-sulphate of iron or copperas is added, and in the summer months permanganate of potash in addition to both.

Where the sludge does not command a sale for manurial purposes it has to be got rid of in the most economical way, so as to avoid creating a nuisance. This is sometimes done by partially drying it in mechanical presses, and so converting it into a partially solid material (having about 50 per cent of moisture) by which it can be carted away and sold or used to fill up low-lying land. At Barking it is taken in steamers specially constructed for that purpose, and is conveyed to the sea, where it is disposed of.

It has been impossible in this paper to do more than touch upon the many important matters that arise in connexion with these subjects. If the observations, however, that have been made elicit opinions from the many experienced and distinguished gentlemen who are present at this Congress, one main object in making this communication will have been accomplished.

L'Assainissement des Villes en Italie.

PAR

Prof. PACCHIOTTI, Sénateur.

L'Italie est en train de se transformer par des réformes sanitaires. Gouvernement, Parlement, Municipalités, hygiénistes, ingénieurs, tous les journaux d'hygiène d'accord veulent rajeunir, embellir, assainir les villes.

Ma communication s'arrête à la question de l'assainissement (*drainage, fognatura*). Deux partis sont en présence, ceux qui défendent le tout à l'égout et ceux qui préfèrent le *separate system* selon Waring.

Parcourons l'Italie. Rome possède depuis 2,500 ans le tout à l'égout, fondé par les Tarquins, continué par la République, l'Empire, les Papes et depuis 1870 par notre Gouvernement.

Le tout à l'égout est en voie de construction à Naples (qui cependant a aussi le *separate system* dans sa partie basse), à Milan qui a introduit depuis 300 ans le *sewage farm*, à Cóni aux pieds des Alpes, à Venise et à Florence.

Ce système est à l'étude à Spezia, Ancone, Bari, Catane, Messine, où d'excellents projets sont préparés.

A Palerme et à Massa Carrara nous trouvons deux projets du système Waring. Dans la grande capitale de la Sicile une lutte ardente domine. Dans la petite Carrara on a construit un petit échantillon.

Et maintenant deux mots pour Turin, dont je viens plaider la cause devant le grand Jury du Congrès, où je présenterai tous les projets, avec une description de la ville.

Voici en peu de mots l'histoire. Première Commission nommée en 1880. Présentation d'un projet du tout à l'égout en 1883. Renvoi à une deuxième Commission qui propose le *separate system* en 1886. Discussions entre les deux partis. Nomination de M. Bechmann pour faire un nouveau projet du tout à l'égout. Nomination d'une Commission de quatre éminents ingénieurs et un savant hygiéniste pour faire un choix entre les deux systèmes. Vote unanime de celle-ci pour le tout à l'égout. Nouvelle hésitation de la Municipalité.

Je suis un partisan convaincu du tout à l'égout à Turin, qu'on dirait faite exprès par la nature pour ce système avec dépuration des eaux et irrigation agricole de vastes terrains très près de la ville.

Je viens implorer un conseil dans cet Aréopage de savants de toute l'Europe.

Je défendrai les propositions suivantes:

1. Chaque ville doit choisir le système qui lui convient, car il n'y a pas un seul système pour toutes les villes sans exception.

2. Toutes les villes qui veulent entreprendre leur assainissement, si elles ont assez d'eau et une pente assez convenable pour entretenir la

libre circulation et empêcher toute stagnation, selon l'aphorisme de Sir Edwin Chadwick, doivent adopter le système du tout à l'égout qui s'approche, plus que tous les autres systèmes connus, de la perfection.

3. Toutes les villes qui possèdent plus ou moins près d'elles des terrains perméables et propres à l'épandage des eaux d'égouts, doivent en profiter pour servir à leurs dépurations et favoriser l'agriculture.

4. C'est contraire à l'hygiène de déverser, *quand on peut l'éviter*, les eaux d'égouts dans les cours d'eau environnants les villes, parce que les analyses chimiques et bactériologiques modernes démontrent qu'elles produisent autant que les eaux cloacales la pollution des fleuves.

Sanitation in India.

BY

BALDWIN LATHAM, Mem. Inst. C.E., Mem. Inst. M.E., F.G.S., F.S.S., F.S.I., P.R. Met. Soc.

There is no country that requires greater attention to be paid to sanitary measures than India, and there is, probably, no country which will repay the labours of the sanitarian better than India, as is already shown by the results accruing from the prosecution of sanitary works and the adoption of sanitary measures which have, wherever introduced, been immediately followed by a marked improvement in the state of public health.

The supply of wholesome water, the construction of sewerage and drainage works, and an effectual and safe method of dealing with the waste products of the vast populations are matters of urgent necessity throughout India. The general habits of the majority of the native population are such as to lead to the pollution of the air, the ground, and all unprotected sources of water-supply.

The dense population living in Indian cities—a density which is in excess of that in any European country—is a condition that points to the urgent necessity of efficient sanitary measures being adopted. There is no wonder that the death-rates in Indian cities are large, as the average density of population may be taken as 100 persons per acre, and in many parts of the cities there is still a greater congestion of the population.

Under existing arrangements the ground of all Indian cities is more or less impregnated with filth and the urinary excretions of man and beast, and so great is this pollution that in most cities local wells have become brackish as a result of ground pollution. Nor is this state of things confined to the cities, for in the villages there is just as great neglect of sanitary requirements, and the cattle often occupy the lower rooms of the habitation, thus adding to the unhealthiness of the dwelling and the pollution of the ground.

The inhabitants of the cities, towns, and villages in India, die of diseases arising from insanitary conditions at a rate of which we have no conception in this country. There are also other causes of death in India (some of which are common to other countries) that influence the death-rate, such as exposure and insufficient clothing during the wet and cold seasons. The natives of some parts of India are also subject to causes of deaths unknown in European countries, such as death from snake-bite, and being killed by wild beasts, but deaths from these causes may be excluded, as they are less than half per cent. of the total deaths in the district most subject to this form of mortality.

The climatic conditions of India cannot be considered absolutely unfavourable to the promotion of good health. The high temperature of the plains of India, having regard to the polluted state of the ground and of the water-supplies, is a condition certainly not favourable to the health of its inhabitants. On the other hand, probably, if it were not for the influence of the sun in drying up and destroying much of the polluting matter, the health of the inhabitants of India might be much worse. The most unhealthy periods in India are certainly not the hottest periods of the year. The high temperature of the ground is unfavourable to health in all those places in which the refuse from the population is stored in receptacles below the ground level. The favourable health statistics of large towns like Bombay and Calcutta show that it is not climate that causes the frightful mortality in many parts of India, but that this is due to the downright neglect of the simplest sanitary precautions.

The fixed wet and dry seasons of most parts of India can be depended upon with a degree of certainty. The excessive rainfalls of one period, compared with the long absence of rainfall in other periods, tend to show that the separate system of sewerage is one which is the most proper for certain places in India, and that the rainfall in these districts should, as far as possible, be completely segregated from the sewage proper. The rainfalls in some of the larger cities are excessive, for in Bombay falls exceeding 4 inches per hour have been recorded, while in a single day over 16 inches of rain have fallen. The average of the heavy falls of rain in Bombay exceeds 2 inches per hour, whilst the average of the daily heavy falls exceeds 7 inches per day. In Calcutta, the rains are not so heavy as in Bombay, but occasionally heavy falls exceeding the rate of 3 inches per hour have been recorded, though on an average rainfalls exceeding 5 inches per day are only recorded once in three years.

The sanitary appliances in use in India are of an extremely varied character. In many cases conservancy is unknown, and the refuse of the population rots at each man's door. In the cities, for the most part, the Halalcore system is adopted, a system by which the solid nightsoil is collected in a basket placed below the closet seat, an arrangement which allows the liquid parts, including the water of ablution, to flow away, usually to the street gutters. Under this system the stercoraceous matters are collected by men and women every day and then carried in

baskets on their heads to some central point where they are deposited in a barrel on wheels and are then carted to some place for disposal. In the cities where they have sewers, these matters are mixed with water and flushed into the sewers; where they have not sewers, the matters are either trenched or buried in the ground or manufactured into poudrette.

The trenching of nightsoil cannot go on in the time of the monsoon, and at this period the material is generally buried in deep pits, to be sometimes resuscitated and manufactured into poudrette. As a rule, the effect of burying this matter in deep pits in the hot soil of India causes a violent fermentation to take place, and an indescribable nuisance to be created. The trenching grounds, too, are extremely obnoxious, and the position of these trenching grounds is ordinarily fixed as a matter of convenience, and often pollutes the underground water, the soil, and the atmosphere of the neighbourhood of a town to a most injurious extent. At Poonah an attempt has been made to manufacture the material into poudrette by admixture with wood ashes and drying in the sun, and under sheds in the monsoon; and it is found that a manure very valuable for some crops can be produced, but that the sale of the manufactured article does not return more than one half of the cost of its collection and manufacture.

In most cities privies are of common occurrence, and the author has seen a structure of this kind in Calcutta, in which the excreta drops into the basement of a many-storeyed building of considerable altitude, where it accumulates to a considerable depth and from whence it is removed in semi-liquid condition by the Sanitary Department. Cesspools constructed in brick, stone, and other materials are in common use, and large earthenware jars sunk into the ground are also used as cesspools, and are emptied at periods more or less remote. The surface of the street in most cities is the receptacle for a large part of the sewage.

In the Holy City of Benares they have had a system of covered sewers in operation for a long period, but these sewers are more or less imperfect in form; yet, bad as they are, Benares is in a much better state of health and has had a lower death-rate than many of the towns that do not possess any such system; and this, in face of the fact that Benares is the home of large numbers of persons who go there especially to die, and is a very crowded city, is a matter that speaks well for the advantages of works of sewerage.

Earth-closets also have been used in India, but it is found that owing to the large amount of earth required their use among natives is not general, as the waters used for ablution necessitate about 5 lbs. weight of earth being used to each inhabitant per day.

With the exception of some of the large cities, the water-supplies are extremely defective. The supplies are usually taken from tanks which are, for the most part, nothing but filthy polluted ponds to which generally the drainage of the village or town has direct access. The tanks in use in the suburbs of Calcutta may be taken as a fair description of those ordinarily used throughout India. Analyses of the

water of these tanks show that by far the largest portion of them might naturally be classed as containing raw sewage.

As an example of the polluted state of the tanks, and of the effects of often filling them in with vegetable and animal refuse, Dr. Simpson, the medical officer of Calcutta, gives a very interesting example in one of his recent annual reports as to the state of these tanks after being partially filled up. A woman residing on the banks of one of these tanks in Shampooker lit a fire for cooking purposes, but after the fuel was consumed the fire continued to burn with a continuous flame, and she was able to cook her food every day for more than a fortnight without being put to the expense of buying fuel. She kept the secret for some days, but at last told her neighbours, who were invited to come and see the wonderful light. Her visitors, however, became so numerous that she made a charge of a pice per head, and by this means, in one day, she realised no less than four rupees. It was a matter of great astonishment, the flame being looked upon by her visitors as the tongue and breath of the devil. The income of the woman was, however, stopped by some of the inquisitive visitors digging up the ground around the house and so allowing the gases of decomposition to escape, after which the fire went out, or only burned fitfully.

The supply of water from wells also is largely in use. The water of all wells within Indian cities must be looked upon with suspicion, as all these supplies are liable to pollution, and in many instances they have become so polluted that they can be no longer classed as fresh water. The wells also, in a very great measure, are liable to pollution from the mode in which the water is drawn by the utensils of each individual using the water, and also by reason of the site of the well often being used for the purpose both of ablution and washing of clothes, and the liability of the polluted waters to return to the well. The running streams of India, to which the natives have access, are polluted from their very sources downwards; but, as a rule, the districts supplied from running streams are healthier than those drawing their water-supplies from either tanks or wells.

Cholera, which is more or less prevalent in many parts of India, is almost entirely due to the defilement of wells, tanks, and rivers. The consuming thirst of the cholera patient leads directly to the speedy contamination of all unprotected water-supplies. This has been shown in the enormous reduction of cholera in Calcutta by the introduction of the public water-supply into that place, and even the recent extension of the Calcutta water-supply to some of the suburbs of Calcutta has produced an immediate and enormous diminution in the deaths arising from this very fatal disease.

The experience in India in connexion with water supplies taken from rivers shows that the rivers undergo a process of purification, and that the waters taken from them, after a sufficient length of flow, and if perfectly filtered, are among the most wholesome supplies in the country, as the case of Calcutta fully demonstrates. There is also abundant experience that the introduction of water into a district will not of itself promote good health, especially if the water supply is taken from

a place liable to immediate pollution; for example, the city of Ahmedabad until the present year has had waterworks, the source of the supply being the Sabarmati River, the intake of the works being actually located within and at the lowest part of the city, below all the points where the river is used for ablution, washing, and other purposes, and is liable to receive the filth of the city washed in with the rains in the monsoon period. Under such a state of things, and in the absence of proper sewerage, Ahmedabad has been very unhealthy, the death-rate of its people having, at times, exceeded 70 per 1,000; and on an average of 11 years—1875 to 1885—it has had a death-rate of 53·15 per 1,000. This state of things at Ahmedabad has just been remedied by moving the intake of the waterworks to a point in the river above the city.

In the city of Poona there is also a water-supply, but no sewerage; and this city, which is much more healthy than most cities in India, does not enjoy that high standard of health which is secured in cities which have both drainage and water supply. For some time it was a question of doubt in India whether or not, owing to the peculiar religious tenets of some of its inhabitants, they could use water which had been filtered and supplied through pipes. However, it appears that the Brahmins have announced that filtered water brought through pipes can be used for all purposes except religious ceremonies.

The quantity of water used in the cities of India would be extremely large, under existing arrangements, if the supplies were constant, as generally the native has cleanly habits, and will not bathe in his own house in water in which anyone else has previously bathed, and, as a rule, water is continuously running to waste all the time he is taking a bath. This habit contrasts strangely with the filthy habits of bathing when using the polluted water of tanks or rivers in common with others.

In Calcutta the intermittent water-supply of 14 hours per day is over 44 gallons per head per day, and in Bombay it is over 20 gallons per head per day; and it is very questionable if the waterworks which are now being carried out in India will afford a sufficient supply of water for the demands of the population, having regard to the way in which the water is used when once introduced into the city. It is imperative, therefore, in all waterworks, that such water fittings shall be adopted as will prevent the waste of water.

The sanitary appliances for the removal of the refuse of the population by water carriage in India must not only prevent the waste of water, but must be of such a character as not to even splash with water the person using them for fear he is polluted; yet these same natives ordinarily bathe in common, and use waters for all purposes of the vilest character, to which there has been access of all those matters which are looked upon as a cause of pollution to the particular individual when he has to use sanitary appliances within his own residence.

Such is the sanitary state of India, that it is recorded that in the North-West Provinces alone, according to the authority of Dr. Hutchinson, the Sanitary Commissioner, that in 40 out of 106 towns in the year 1889 the deaths exceeded the births. He mentions that the rate of mortality

in the small town of Lalitpur, which had a population in 1881 of 10,614 persons, was 81·48 per 1,000, of which 27·32 per 1,000 was due to deaths from cholera.

Small-pox also not infrequently produces a very high death-rate in the districts in which vaccination has been neglected, and in the town of Sandila, containing in 1881 a population of 14,865, the death-rate from small-pox alone, in 1889, was 17·02 per 1,000.

The deaths from fever in India have a different signification as compared with England, for in some places nearly the whole of the mortality is ascribed to fever. This is due to the imperfect system of the registration of deaths, as most authorities in India agree that in all probability the actual mortality from fever does not exceed 25 per cent. of the total deaths. The general cause of death, except in the case of cholera and small-pox, is not distinguished by the native collector of statistics, and consequently every disease in which there have been feverish symptoms is usually put down to fever. As an illustration, in Cawnpore, the death-rate from fever is stated to be 39·92 per 1,000 of the population, whereas the death-rate from all causes stands at 49·60. The city of Cawnpore, in the year ending March 1890, had a death-rate of 53·11 and a birth-rate of 40·46. It should be noted that in India very many deaths are not recorded, so that the death-rates in all cases may be taken as being higher than is actually given by the figures.

As a rule, the towns in India are very much more unhealthy than the districts in which they are located. In the North-West Provinces the average death-rates of all the towns exceeded, on an average, during the past five years, that of the districts in which they are located by 5·13 per 1,000. It is also found that women, who are more exposed to the insanitary conditions of home life, suffer more than the males. Dr. Simpson's returns for Calcutta show that the deaths of males for four years, from 1886 to 1889, was 23·4 per 1,000, whilst it is found that the deaths of females in the same time was 31·4, or the female rate of mortality was 36·5 per cent. greater than that of the males. It should also be noted, especially with regard to the position which females occupy in India, that the suicides amongst females are three to one of the males, or exactly in the reverse proportion to that of England. This is, in a great measure, attributed to the restraint put upon females.

As a result of sanitary work in the case of the city of Calcutta, we have the means of comparing the health of that city, which receives a good supply of wholesome water, and has been sewered, with that of the suburbs, which have received neither of these advantages. From Dr. Simpson's return for the 12 years 1877–1888 it is found that the average death-rate of the city of Calcutta was 28·7 per 1,000. In the same 12 years the average death-rate in the suburbs of Calcutta was 47·25 per 1,000. The population was almost twice as numerous in Calcutta as in the outside district, yet the outside district had an average death-rate exceeding that of the city itself by 64·63 per cent. These figures at once show the incalculable advantage to any place adopting sanitary measures, for it cannot be said that in Calcutta the sanitary works, as regards its system of sewerage, are by any means perfect, and nearly the

whole of the benefits which have accrued in the case of Calcutta has been shown to be due to the introduction of a wholesome supply of water; and this may again be inferred from the fact that in the suburbs of Calcutta that have been supplied with wholesome water and have no sewerage works, the death-rates have immediately been reduced. Moreover, it was found that when Calcutta was first supplied with water in 1876, before its sewerage works were carried out, the average death-rate for five years, before the supply was introduced, was 38·2 per 1,000, while the average death-rate for the subsequent five years was 24·6 per 1,000, or a reduction in the death-rate of 35·6 per cent. The authorities in India usually calculate that for every death recorded there are at least 20 cases of sickness. In all probability the number may stand much higher, as by reference to the report of the Commissioners at Poona, I find that in the year 1885, out of a population of 100,000 persons, it is recorded that 51,842 were admitted to the hospitals in this city in one year.

Investigation of the sanitary state of India shows the urgent necessity that exists for sanitary measures, and it is gratifying to know that the Sanitary Commissioners of India are fully alive to the advantages of such measures, and, aided as they are by the supreme authority and by the Governments of the various provinces, it is hoped that in the course of a few years much will be done to mitigate the evils arising from the insanitary state of the large towns and of the country generally.

French and English Systems of Sewerage.

BY

JAMES LEMON M. Inst., C.E., F.S.I., F.G.S., Past President of the Association of Municipal and County Engineers.

The author desires to call the attention of the Congress to the systems generally prevailing in the two countries.

In the year 1884, the author prepared a report upon "The assainissement of the Town of Hâvre," by the direction of the French Government, and in so doing, he had many opportunities of comparing the French and English systems. It is a common practice to discharge the soapy water, the urine, and the dirty water from the kitchens into the open gutters or channels of the streets by means of pipes placed against the external walls of the houses, with small troughs or receivers at each story.

In those streets with little fall, evaporation takes place from the arrest of the flow, or by the deposit of matters in suspension, and nuisances, detrimental to the public health, constantly arise from the dirty condition of the channels or gutters referred to. As these gutters discharge themselves into the sewers by untrapped openings under the

kerbs of the footway, the smell arising from the sewers is freely discharged into the air immediately under the noses of the passers by.

It is true that this state of things is somewhat modified by the waterposts which continually discharge themselves into the gutters, and keep up a small flow of water.

This attempt to wash down the gutters cannot be called a flush, it is feeble at the best of times, although the same quantity of water consumed by a proper arrangement of flushing-tanks would be sufficient for the purpose.

The modes of disposal of excrementitious matters which have come under the notice of the author are three in number, the first, or least imperfect, which is applied in the new houses, consists of a watercloset with a small supply of water, discharging by means of soil pipes into a cesspit, generally situated in the yard of the house.

This cesspit is generally in masonry, and is divided into two parts to separate the solid matters from the liquid, and from the portion containing the liquid a pipe is connected with the sewer.

The solid matters remain in the first compartment, the liquid passing through the perforated divisor into the second.

By this means the emptying of the cesspit is postponed to a more distant time.

The second system consists of closets, supplied with water or not, situated on the various floors or in the yards, and connected with one cesspit, also in masonry, conserving the solids and the liquids until it is full. This cesspit has to be emptied frequently.

The third system is principally found in the old parts of the towns in which the population is the most crowded. It consists of a tub placed in the attics or the cellar, sometimes without either ventilation or light, near to inhabited rooms.

In some of the lowest class of houses the condition of these tubs defies description. They are emptied more or less regularly, and in order to do so it is sometimes necessary to carry them down narrow stairs, and even through the rooms, to the carts in the streets, from whence they are removed to the outside of the town, leaving noxious and pestilential odours behind them on their route.

It is impossible to conceive any system more calculated to spread cholera, typhoid fever, or other diseases amongst the inhabitants. It may be said these are matters more affecting house drainage than town sewerage, but the latter entirely depends on the house sanitation, and it is impossible to separate them.

The French system of sewerage consists in the establishment of sewers, called collectors, in the main streets, into which smaller sewers discharge themselves from the inferior streets.

These collectors are of large sectional area, and are designed to take the rainfall and the washings of the streets, no intercepting gulleys being used; the result is, deposit rapidly accumulates in them, and special means have to be adopted to flush it out or remove it by hard labour.

The system may be briefly described as "All to the sewer from the streets, and as little as possible from the houses." Some French engineers have now become converts to the principle of "Tout à l'Egout," "All to the sewer," and if that be adopted, an entire revolution of the French system must naturally follow.

The English system consists in the rapid and entire removal of all excrementitious matters from the houses to the place of disposal before decomposition sets in.

Much has been said and written against the English watercloset, but it still holds its own as the cleanest and best receptacle yet devised by man. With the best description of closets and well ventilated soil pipes, there is no fear whatever of what are called sewer gases.

In connexion with the watercloset we have the water carriage system, and the English mode is to adapt the dimensions and fall of the sewers to the work they have to do, so that in ordinary working there shall never be less velocity than two feet per second.

Pipes made of glazed stoneware are now almost universally used in England for small sewers, with man holes or inspection shafts about every 100 yards, and the sewers laid at right-angles therefrom. They afford an effective means of rapid sewage removal, and are in every respect superior to the sewers of masonry, brickwork or béton used in France.

The English system differs from the French system in one important principal, and that is the removal of the polluted water from the houses is always the first consideration, whereas in France the removal of the washings of the streets is considered more important.

It is alleged that the water carriage system as carried out in England, increases the difficulty at the outfall; this is no doubt true, but in towns where waterclosets are not generally used, local authorities are compelled to deal with the sewage to prevent pollution of rivers.

Various modes of purification have been adopted in England, such as irrigation, intermittent filtration, precipitation, &c., and in some cases a combination of the two modes. In the large majority of cases these various systems are effectual.

By the French method, the volume of sewage is less, but the decomposed sewage from the cesspits, which is discharged into the sewers, causes as much pollution at the outfalls as the English system, in which the use of waterclosets is general and 20 to 30 gallons of water per head per day are consumed.

Something no doubt can be said in favour of the French subway, but the same arguments may also be used in favour of the English subway, the only difference being that the sewer channel is open in the former, and covered in the latter.

In the opinion of the author there is only one true principle of sanitation, and that is, the rapid and constant removal of all excrementitious matters from the houses to the place of disposal. It is urged that the system adopted by the best English sanitary engineers affects this object in the simplest, most efficient, and most economical manner, and that the French system does not.

The best test of all sanitary work is the effect upon the public health. In the best drained towns in England you have a low death-rate, and although this is also due to good water, healthy dwellings, and other causes, house drainage plays a most important part, and without it you cannot get a low rate of mortality.

The author would compare two seaport towns in the respective countries with which he is very familiar, viz., Hâvre and Southampton. There is no reason whatever why Hâvre should not be as healthy as Southampton, yet the death-rate in Hâvre is more than double that in Southampton.

The same comparison may also be drawn between the inland towns of France and England to the disadvantage of the French towns, and, in the opinion of the author, the cause is to be found in the want of efficient sewerage and house drainage.

The Removal of Sewage after leaving Buildings.

BY

REGINALD E. MIDDLETON, Mem. Inst. C.E.

The writer proposes, in the following remarks, to give a short description of different systems for the removal of sewage matter from houses and streets to the sea, to land, or otherwise; he desires to set forth as simply as possible the difficulties attendant on each system which has been adopted in the endeavour to find an efficient, economical, and rational means of removing sewage from its point of origin to that of disposal.

The system of sewerage which has been most generally adopted in this country, and which has existed from the earliest times, is that of large sewers calculated to admit of the passage of all the sewage matter and storm-water which the district receives.

So long as it was possible to turn the sewage thus collected into the nearest river or stream, or into the sea direct, this system of large sewers was the natural sequence of such disposal. But the injurious consequences of this course having become apparent, in the dangerous pollution of rivers and streams, and the offensive condition of the sea-shore in many places, whereby the country was to a considerable extent deprived of its most natural and least artificial source of water supply, it became necessary to enact that sewage matter shall not be turned into rivers unless it has been previously rendered innocuous. This enactment obliged engineers to consider the most economical and efficient means of transporting sewage to much greater distances than was formerly thought necessary; and as storm-water forms a very large proportion of the mass of sewage to be carried, one of the first questions

If the sewers are to be separate from the watercourses, the gradients of the former will be much steeper than those for the latter conduits. It would in most cases be necessary to have two sewers in each street, for all the house drains could not be connected to one, considering that the covered watercourse would be in the middle; the crossings of streets would also offer considerable difficulties. But nothing is impossible; and these difficulties could no doubt be surmounted, indeed, this has been done. The question then arises, however, of how far it is safe to pass water mixed with the sweepings of streets, of courts, and of yards, and the washings from the roofs of houses, directly into the nearest watercourse without purification.

It has been contended lately that the number of microbes present in the dust of streets is greater than in sewers, due it is said to the more free circulation of air in the open than in the covered sewers, and this has been used as an argument against the ventilation of sewers. It may be that the number of microbes is greater in the streets than in the sewers, but this does not prove that the larger number are more dangerous to health than the smaller supply, nor does the view that more is to be feared from street sweepings than from sewage agree with experience, it having been frequently noted that foul watercourses remained innocuous so long as they were open to the air, but became exceedingly injurious to health when covered in. However this may be, the question remains, is it safe to turn water which has passed from the roofs of houses, and over the surface of streets and yards, direct into the nearest watercourse, and the writer does not feel able to deal with the chemical view of this subject.

The advantages which the separate system offers appear to be:—(1.) The use of very small sewers. (2.) A fair amount of regularity in the amount of sewage passing through the sewers, which will not vary greatly either in quantity or quality, and which will at certain known times in every day carry a known maximum and minimum of sewage. (3.) The gradients can be arranged to give a minimum rate of flow which shall not allow of deposit. (4.) Where pumping has to be employed, the volume to be pumped is reduced to a regular diurnal unit, as against a quantity which may vary in the proportion of from 1 to 25 or more according to the rainfall, and which necessitates the use of pumping machinery, tanks, and other appliances calculated to deal with the larger quantity. (5.) The comparatively small alteration of level of the sewage matter in the sewers, and the fact that the variation in the rate of flow would be reduced and the average rate made higher, should tend to prevent pressure from the evolution of gases, and should shorten the time of delivery—and therefore that in which fermentation can take place—and should tend to health. (6.) The heavier matter, such as road scrapings, coaldust, etc., is not passed into the sewers, but into the watercourses, and the former should, therefore, be maintained free from deposit with great facility. (7.) From the small size of the sewers and the comparatively regular flow of sewage in them they offer great facilities for more thorough and regular ventilation than has been hitherto found possible in the larger sewers.

Against these advantages must be placed the increased complication of the drainage system, not as a whole, but in the streets; and the fact that as the gradients of drains of small size must be steeper than of those which carry a larger volume, the height through which the sewage has to be pumped, where pumping becomes necessary, will be greater than for large sewers, though the quantity to be dealt with is much less, the proportion can, however, be only decided for each particular case.

The separate system appears to offer many advantages for the collection of sewage, in very flat districts, in receivers of limited capacity placed at comparatively short distances apart, whence it may be discharged or pumped to a higher level by steam power or by water or air pressure supplied from a central station. It is thought that the use of air is most advantageous for this purpose, as very much smaller pipes can be used for its transmission than is possible when water is employed as the motive power; a speed of 60 feet per second being quite admissible when air is used, while 3 feet per second would be about the limit for water; and there is no shock with the first-mentioned form of power, while there is considerable shock with the second. The efficiency obtained with the use of compressed air is considerable, and might, it is thought, be greatly increased by its more careful and scientific employment, both as regards the construction of receivers, the height of the lift, in the compressing machinery, by the reduction of waste space, and in heating, and by the expansive use of the air.

Where water is used as the motive power, space must be provided in the sewers or watercourses for the exhaust water, while the air may be discharged into the sewer without taking up useful space, and may serve to ventilate it. On the other hand, this air, which has been in intimate contact with sewage matter (presumably, however, little fermented) may be discharged into the streets through some opening, and may become a source of danger.

The writer wishes to call particular attention to the necessity which exists for considering each locality on its own merits and conditions, and for providing a system of sewerage which is applicable to those conditions. The same sewers which may do very well in a hilly country are not adapted to one which is flat. A system which is successful in a temperate climate, where the rainfall is moderate and much diffused, is not necessarily adapted to a tropical country, where the heat is great, and the rainfall is excessive and concentrated. The separate system is, no doubt, not universally applicable, but the writer believes it to have many advantages which only require consideration to be recognised.

The Sanitation of a Mining Settlement.

BY

A. MAULT, Engineering Inspector of the Central Board of Health, Tasmania.

In the neighbourhood of Mount Zeehan, on the West Coast of Tasmania, there occur immense deposits—perhaps the largest in the world—of lead and silver ores. These deposits are attracting a large population. Six months ago there were about 400 people in the district, either working the mines or prospecting the country; to-day there are more than 4,000, and the number is continually increasing.

Under the existing mining law it is impracticable to constitute any municipal authority in the district, as the inhabitants of municipal towns acquire rights that would interfere with mining. This law is to be amended in the next session of parliament. In the meantime the Government has undertaken the more urgently needed of the works required at the rapidly-growing town. A local board of health has been appointed. It has no rating powers, but has ample authority to compel the carrying out of such works as are usually done by owners or occupiers of property in their individual capacity; the works usually done by communities in their collective capacity are those undertaken by the Government.

The principal part of the settlement has taken place along three quarters of a mile of the road leading from Trial Harbour—a small inlet available only in fine weather—through Zeehan to Mount Dundas. It began, as all mining settlements begin, with a few huts and tents on each mining claim. Publicans, tradesmen, and store dealers followed. The surveyors of the Lands Department laid out a township on what they considered a suitable site, and the whole of the building lots upon it were immediately bought. But as it is about a mile and a half from the principal mines yet developed, hardly any building has taken place upon it. What has induced building has been, not suitability of site or of ground, but proximity to work; and consequently the great majority of the houses are built upon land quite unfit for such occupation.

At a height of about 550 feet above the level of the sea, and 13 miles distant from it, there is a little valley traversed by several rivulets flowing into the Little Henty River, covered with thick forest, and surrounded with hills that shelter it from every wind. The prevailing rock is slate, which comes up close to the surface in most places; and what little soil there is on the swampy flat forming the bottom of the valley is the retentive clay produced by the weathering of the slate. The forest is of what would be extraordinary density in any place outside Tasmania. On an acre of it, and not an exceptionally densely covered acre, there were counted 96 trees girthing from five feet to 22 feet, 1,560 spars and saplings girthing from one foot six inches to

five feet; and the undergrowth was of "tea tree, with its upright spear-like stems growing so thickly together as to be impassable without chopping a track. The yearly rainfall is probably over 110 inches. The rivulets traversing this swamp were so blocked up with fallen trees and branches as to render it difficult, except in very dry weather, to determine which were their real beds; and in the midst of this the settlement was formed.

In its beginnings a mining settlement is not a savoury place. The huts or tents are usually not kept scrupulously clean. They are surrounded with emptied and partially-emptied preserved meat and jam tins and bottles, with bones and potato parings in addition if fresh meat and vegetables are to be had. There are no latrines, and the surrounding bush is polluted with ordure. If horses be kept, the manure is never removed. When the huts and tents are replaced by houses, the refuse is still simply thrown out of the back door, and the latrine is often a seat with or without a hole dug in the ground. There are no drains, and the slops are thrown on the ground close to the door. At Zeehan all this naturally aggravated greatly the original unwholesomeness of the swamp. Yet in it houses, hotels, and shops were built as fast as materials could be procured. Some of the hotels accommodate more than 100 guests each, and others still larger are being built.

The first work done was to clear out, straighten, and lower the beds of the two principal rivulets. This was not a very easy work to do satisfactorily, as the ground, where not rock, was one mass of tangled roots of all sorts. None of the forest trees here have tap roots, consequently the whole surface of the ground is covered with the ramification of roots—some of enormous size. The following of definite lines, and the making of clean slopes is consequently difficult. The work has already produced a marked improvement; the level of the "ground water," which was formerly practically identical with that of the surface, has been lowered three or four feet; and it is now possible for the inhabitants to drain off the large quantities of stagnant water that covered much of the surface in wet weather, and left a corresponding surface of green fœtid slime in dry. Many of the houses were built on short piles on land in this condition.

With respect to the sewerage, the preliminary difficulty was to procure material. The 13 miles of road to Trial Harbour is of such a nature, and in such a condition, that not only does haulage at present cost £5 a ton, but it is also practically quite impossible to secure the safe transport of any breakable material. Earthenware pipes were, therefore, out of the question. The use of wood was discarded for various reasons, and that of rivetted wrought iron pipes adopted. Sheet iron of No. 18 gauge was employed in six-feet lengths, the ends being slightly spigotted and faucetted so that the joints might overlap about two inches—the spigot end being left unrivetted for that length. After rivetting, the pipes were heated and plunged into a bath of boiling pitch and tar which, when dry, formed a hard adhesive coating, sufficiently elastic to form a practically watertight joint for sewers not subject to the pressure of a head of water. The junctions were easily made with

branch pipes at an acute angle, each one having also a short vertical branch, to serve as an inspection hole, and large enough to remove any matter that would choke a four-inch house drain. While being laid, the position of each inspection-hole was permanently marked on the surface, and also fixed by recorded cross measurements. Curved pipes were expensive to make, so their use was as much as possible avoided by putting a manhole at every change in the direction of the sewers.

Zeehan is a mining town, and the whole district is a mining district; consequently, when lead concentrating work is largely carried on it will be quite impracticable to prevent the metallic poisoning of the streams running through it, rendering their waters unfit for animal consumption. But such water does not give off the noxious emanations of sewage. So, though it has not been thought worth while at present to purify the sewage before its discharge, care has been taken to make provision that the eventual outfalls shall be at a distance from all settlement.

As no good bricks are yet made in the district, and the bad ones made cost £10 a thousand, the manholes of the sewers, and the trapped and ventilated catchpits for house and yard drainage were made in wood. Huon pine, *Dacrydium Franklinii*, is an admirable wood for these purposes, being almost imperishable. Water troughs, laid partly in the ground for intermittent irrigation work, are still quite sound after 40 years' use; and the slabs of it set up instead of headstones on the graves at Settlement Island, Macquarie Harbour, though dated 1825 and 1826, are still quite as good both above and below ground—the arrises only being very slightly weathered. The wood of the Blue Gum (*Eucalyptus globulus*) is also almost equally indestructible, and it was principally used.

While the sewerage works were being carried on, the local board of health, having obtained from the Government the grant of a suitable piece of land as a depositing ground, entered into arrangements for the periodical removal and burial or destruction of all refuse. As there is no water supply at present available for waterclosets, notices were issued to every householder to construct and maintain a proper earth-closet of a certain pattern, and to provide suitable receptacles for house refuse; and the weekly cleansing of both these forms part of the arrangements above referred to. Notices were also served for the thorough cleansing of all yards and outbuildings. As the sewers were being designed, the details of all house drains were also settled, and the owners of all property were called upon, immediately a sewer was available, to construct the drains accordingly.

Nothing was done by the Government with regard to a water supply as a private company is promoting a Bill in Parliament for establishing waterworks. At present nearly all the houses have galvanised iron roofs and large tanks, and the large rainfall ensures a pretty constan supply.

Apart from the population settled in houses, there is an almost equally large population dwelling in huts or tents. Where these are occupied by miners, and erected upon the claims of the companies for

whom they work, the companies are held, under the byelaws of the local board of health, to provide for their sanitary condition. The difficulty is with people otherwise employed, and apparently too poor to build houses or rent them. They are allowed to pitch tents on the unoccupied parts of mining claims. These tents and their surroundings are usually indescribably squalid and filthy. Where a Government reserve or other land is available for the purpose, it is arranged that camping shall only be allowed on it, and under the control of the local board of health, which sees that proper sanitary provision is made in return for a small weekly payment. Hitherto this has not been possible at Zeehan; but some of the tents have been dealt with. They had been put upon ground already polluted with filth and sewage. They were taken down, the ground levelled, the surface burnt, and then the actual site to be occupied by the tents covered with a layer of charcoal—very easily procurable here—a wooden platform or floor constructed, and the tents re-erected thereupon.

All this is not a record of engineering difficulties overcome, but a narrative of how the exceptional condition of things that is sometimes met with in new communities, and which urgently required to be immediately dealt with, was so dealt with in a simple, economical, and, above all, effectual manner. Some of the work done is necessarily of a temporary character; but none of it is useless, all of it is well worth what has been spent upon it. When the railway is completed to Zeehan other means will be available, and the work will have to be greatly extended, commensurately with the extension of the settlement.

DISCUSSION.

Professor H. Pacchiotti said that one of the great sanitary reforms in Italy had reference to drainage, which had been overlooked for centuries. In Rome, in the days of the Tarquins, the great canalization was begun, on the lines of what the French called *tout à l'égout*, and it had lasted for 2,500 years. The system of *tout à l'égout* had acted perfectly well under the Monarchy, the Republic, and the Empire, as well as under the Popes, and under the present Italian Government. During the last ten years the same system had been followed in Naples, Milan, and Turin; and it was now being studied at Spezia, Reggio, Emilia, Ancona, Bari, Catane, and Messina. The same system, too, had been adopted by the great men who had formerly lived, and were still living, in London. There were some who preferred the separate system. The Waring system had been advocated by some, but not with great effect in Italy. There were only two towns where that method had been tried. The separate system, however, was one thing, and the Waring system was another. For the last 10 years in Turin a great struggle had taken place with reference to the drainage. He was himself a member of the Municipal Council, and he had worked and spoken a great deal on the subject of the *tout à l'égout* principle. The town was of such a character that it seemed made almost on purpose for that system. A little town had begged M. Bechmann, of Paris, to prepare

a plan according to the *tout à l'égout* system, which had succeeded very well, and it had been approved by a commission to whom it had been submitted. He had already presented a summary of the conclusions arrived at by this commission. Professor Pacchiotti finally alluded to the movement then on foot in France for erecting a monument to the memory of Durandclaye, whose earnest and energetic labours deserved the cordial sympathy of sanitarians throughout the world.

Col. Alfred Jones said he should like to enforce almost every word contained in Mr. Middleton's paper. His attention had been drawn to the subject for the last 20 years, during which he had worked a great deal at it with the view of ascertaining whether sewage farming would pay or not. The paper had referred to the necessity of the separate system. He had been arguing for the separate system for years from a practical point of view, maintaining that it was almost impossible to utilize sewage which was subject to extreme variations due to the weather. If they once admitted the rainfall into the sewers there was no limit whatever. As the author had pointed out, the flow of sewage due to the water-supply alone was a comparative constant quantity; it might vary from hour to hour, but as compared with the ungoverned forces of the rainfall it was very easily calculated. With regard to any lifting power that was required in the transport of sewage from the house to the land, Mr. Middleton had very wisely said that the separate system was very necessary to equalize that pumping power. He would not go into the question as to whether water-power or air-power was best, but he entirely agreed with Mr. Middleton that air was not subject to the disadvantages of water. If they employed water-power to lift, they only added to the quantity of liquid to be lifted, they had to lift all the clean water they used, whereas the air was dispersed at once, blown off, and used for ventilating the sewers.

M. Bechmann (speaking in French) said that Mr. Lemon had made a comparison between the two systems, and had easily shown the superiority of the English system to what he had called the French system. He (Mr. Bechmann) wished only to protest before the meeting against that appellation, which he considered to be thoroughly inaccurate, and which he should not like to see introduced into the technical language of the Congress of Hygiene. As Prof. Pacchiotti had said, the honour of having opened the way of hygienic reform was due to England. The method which Mr. Lemon had called the French system was simply the practical mode formerly adopted in countries which had not entered upon the gigantic sanitary movement of later days, the initiation of which was due to England. That system was not peculiar to France. All the great towns were endeavouring to find the means—not always easy, since they were not as rich as English cities—of adopting a system of drainage which should have the effect of diminishing mortality. He might cite the example of Marseilles, the second city in France, which had very recently obtained an Act of Parliament authorising the expenditure of 33,000,000 francs in order to establish what Mr. Lemon had called the English system of sewerage. There was no general mode of procedure applicable to all places. In each country it was necessary to modify the system in order to adapt it to the customs and ideas of the people. He asked the members of the Congress to admit with him that there was no system of "French sewarage"; the universal system was that which England had initiated, and which other countries were adopting.

Mr. Richard Read (Gloucester), in commenting upon the paper read by Mr. Middleton, said the separate system, as was generally known, had its origin in consequence of the difficulty of dealing with storm-water at the sewage outfall. Anyone who had to deal with the sewers of a town knew the difficulty of having a duplicate system to which connexions could be made, and the confusion which arose from making connexions with two separate systems of sewers in the same street. He thought the better plan of dealing with the separate system was to have all the connexions made with the foul-water sewers, and in order to do that to take a definite small proportion of the rainfall into those foul-water sewers. In that way they would get the dirty water, which is the first flush of the rainfall, into the foul-water sewers, and then the comparatively clean storm water, which followed afterwards, would, by means of weirs and overflows, find its way into the storm-water sewers. The street gullies could then be directly connected with the foul-water sewers, and they should be very numerous; being numerous, they should also be easily cleaned so as to keep the greatest possible amount of solid matter out of the sewer. It was suggested that the system of weirs or overflows from the foul-water sewers into the rain-water sewers might in some cases necessitate pumping; but he took it that if all the rain-water flowed into one set of sewers, it had to be dealt with at the outfall by pumping. It was, therefore, a choice of evils; but in many cases weirs or overflows could be taken directly into the rain-water sewers without pumping, and he believed that would be the best plan, where possible.

Mr. J. T. Noble Anderson (Melbourne) asked Mr. Mault the dimensions of the wrought-iron pipes he used, and if he could give any idea as to their cost. He (Mr. Anderson) had carried on similar works to those which Mr. Mault had in charge, on some camps and public works in Victoria, and found that he could get the red gum tree troughs constructed for about one-third the cost of wrought-iron pipes, and they appeared to be more durable and more easily flushed. No doubt it was a question of economy that led to the use of wrought-iron pipes, but his own impression, from seeing these pipes used, not only in the Melbourne and Victoria water supplies, but also in the preliminary sewage works of Melbourne, was that they had been very much over-estimated with respect to durability. The asphalt coating corroded very rapidly, and allowed a rapid corrosion of the pipe. The Melbourne people had at the present time sent several of their leading practical engineers over to America to study the American modes of coating the wrought-iron pipes. He would like to ask Mr. Mault if economy was the chief reason for choosing wrought-iron instead of wood troughs for conveying away the water? Also his experience with respect to the length of time wrought-iron pipes would last?

Mr. Gilbert Thomson (Glasgow) wished to make one or two remarks on the separate system, chiefly with regard to its applicability, to a limited extent, in the case of small towns or large villages with from 2,000 to 5,000, or 8,000 inhabitants. Such a town or village very often came into the hands of the sanitary engineer with a system of drainage more or less deficient; the whole of the storm-water, together with the sewage water, being carried off by a natural watercourse, which ran either through or close by the town. Such villages or towns had a very large drainage area compared with the roof area, and the streets of these villages were practically country roads in place of being highly-polluted town

streets. The pollution from these streets consisted mostly of road detritus, and to a very small extent of the manure which formed a large portion of town mud. The practice he had adopted in such a case was to allow the roof-water to go into the sewage system, while the street-water and the storm-water was allowed to go by the old system of sewers into the drainage system of the place. He believed that such a compromise was best suited for such places, because, if they kept out all the roof-water as well as all the storm-water they would require to have, in the first place, for every house two sets of drains, and that meant an expense to the owners which they would be very unwilling to incur; in the next place the roof-water, which was a comparatively small proportion of the total rainfall, was an advantage in helping to flush and cleanse the sewers. He, therefore, believed that in the case of such a small town as he referred to, the proper course would be to allow the roof-water to go along with the sewage into the new system of sewers, and that the old system of sewerage might be allowed to take the street-water and all the other rainfall from the district, and convey that into the nearest watercourse, which probably up to that time would have received the whole of the drainage.

Mr. James Thomson (Edinburgh) said that one of the dangers of the separate system was, that unless it was under complete supervision there was risk of having the rain-water pipes ventilating the common sewers. With regard to the drainage of villages, one of the best ways of dealing with a separate system, if it was desirable, was to put in overflow sewers. Wrought-iron pipes had been referred to. He had had some little experience of wrought-iron pipes in connexion with main sewers. He had seen pipes which had been in for 40 years, and were uncoated, which were in first-rate condition. They seemed to be preserved by the coating which formed upon the interior from the sewage, and unlike clean-water pipes, they did not seem to corrode.

Mr. Sijmons (Rotterdam) wished to speak of a system which had been working in Amsterdam for the last 10 years, and in which very great improvement had been lately introduced. The Liernur system, as employed in Amsterdam, was arranged for populations of 100,000 and of 50,000. It was directly connected with a pumping station. Until recently all the collected fæcal matters were dealt with at the public cost, but the town had now given over its fæcal matter to be dealt with by a company who treated it with sulphate of ammonia. The cost of this process up till some time last year was 61 cents per head, nearly 1*s.*, but since this fæcal matter had been treated with sulphate of ammonia the cost had been reduced from 61 cents to 44 cents, that was to nearly 9*d.* By the Liernur system fæcal matters were excluded from the public rivers. He knew very well the difficulty of applying every system to an old town. In the new parts of cities they would adopt the best system in existence, and could construct a good separate system like that at Vienna.

The President wished to say a word with regard to the question of the durability of wrought-iron pipes. It should be remembered that there were two factors which affected the life of a wrought-iron pipe, first the soil in which the pipes were imbedded, whether it contained any amount of salt, such as was found near the sea shore in a porous soil, and also (and this was a very important consideration) the character of the fluid that was passed through the pipes. If they were near a town with large chemical manufactories they could very well understand that the life of

the pipes would be very much diminished by reason of the chemicals passing through them.

Mr. H. A. Roechling, (Leicester), said that reference had been made to what Professor Pettenkofer had lately demonstrated at Munich, viz.: that the sewage of Munich could be discharged into the Isar without any detriment to the river itself. In order that this statement might not be misunderstood, and that the veteran sanitarian might not be misrepresented, he wished to give the following particulars in addition to those given in Professor Robinson's paper. Professor Pettenkofer, in 1867, in his report on the drainage of Basle, advised that town to exclude all fæcal matter and urine from the sewers, as London had proved the fallacy of looking upon public river-courses as the channels for conveying away the liquid refuse of towns. This certainly looked as if Professor Pettenkofer had then been an opponent of the "water-carriage" system. In 1876 he had, however, altered his opinion, having, in the intervening years, examined the question very thoroughly; and he now held that the system of carrying away by water all fæcal matters, &c., was right in principle. When the late Mr. Joseph Gordon, who for some months held the appointment of Chief Engineer to the London County Council. designed his scheme for the main drainage of Munich in 1878-80, he recommended the adoption of the system of "water-carriage" pure and simple, and was backed up in this by Professor Pettenkofer. The authorities however, took a different view of the matter; they adopted some portions of Mr. Gordon's scheme, and made the sewers big enough to carry, eventually, the sewage and the rain-water, but they did not admit fæcal matters into them; that was a question left open for the future to decide. The matter had now again cropped up in Munich, as another main intercepting sewer would have to be constructed, and the Mayor thought this was a good opportunity to re-open the whole question. He, therefore, recommended the construction of this additional main sewer, the admission of all fæcal matters, &c., into the sewers and the discharge of the sewage direct and without purification into the river Isar; but he added to this recommendation, that all sewers should be kept at such a level as to admit of the treatment of the sewage by precipitation or by broad irrigation, should such a course be hereafter found necessary. Professor Pettenkofer thoroughly supported the proposition of the Mayor, having examined it very carefully. He was of opinion, that the direct discharge of the Munich sewage into the Isar would not produce pollution, as was generally feared; the velocity of the river and the quantity of water flowing in it, even during the time of minimum flow, being sufficiently great to prevent it. He based his figures upon a ratio of dilution at low water of 1 in 40, reckoning that about 1 cubic meter of sewage would be mixed with 40 cubic meters of river water in the course of a second. The minimum discharge of the Isar was 40 cubic meters per second with a velocity of 119 centimeters per second; the average discharge 110 cubicmeters per second, with a velocity of from 145 to 188 centimeters per second; and the maximum discharge amounted to 300 cubic meters per second, with a velocity of 211 centimeters in that time. From his examination of the river above and below Munich, at times of low water and during periods of flood, he felt convinced that the sewage of Munich would not pollute the Isar. Far more organic matter than would ever be carried to the Isar by the sewage was in the river at flood times. It would lead too far to follow Professor Pettenkofer through all his analyses and arguments; it must be sufficient to say that his reasoning

was so close, that, theoretically speaking, the deductions from his figures could not be otherwise than correct. It remained, however, to be seen whether this theory was borne out by the actual state of the river after the whole of the sewage had been discharged into it for some time, or whether some of the premisses from which he had argued had not been sufficiently examined. Should it be ascertained that pollution of the Isar had commenced, or should the farmers of the district express a wish to utilize the sewage, then it was a comparatively simple matter, to divert it from the river and to employ it in the cultivation of the soil. Professor Pettenkofer's deductions had reference only to the case of Munich, and every case required a fresh and very careful investigation, as it was the proportion existing between the velocity and quantity of the river water and the velocity and quantity of the sewage that governed the decision. Wherever the self-purifying powers of a river would be overtaxed, then pollution, would be the natural result. With regard to the remarks of Professor Pacchiotti, he, (Mr. Roechling) could not agree with his opinion that, as far as sewarage and sewage utilization was concerned, France occupied the foremost position on the Continent. Having carefully gone into this matter, he believed that the sanitation of German towns, especially of Berlin, was far above that of Paris. Whilst Paris was in the unfortunate position of not knowing what to do with its sewage, Berlin had solved this problem, and utilized its sewage on large irrigation farms; it had thus set an example to the whole world. The total acreage of all these farms amounted now to nearly 19,000 acres, of which 8,000 received sewage during the last year. The utilization of the Berlin sewage did not cost quite a penny in the 1*l.* of the rateable value, and the results from a sanitary point of view had been marvellous. He had gone through all the analyses taken since 1882, and it appeared that since that year, on an average 98 per cent. of the organic pollution had been abstracted from the sewage on the farms, a result which he believed had never been attained before by any process for any length of time.

As to the separate system referred to in Mr. Middleton's paper, this question required to be considered under two heads, viz.: first, in connexion with an existing drainage scheme, and secondly, in connexion with the construction of a new one. When he was with Mr. Gordon at Leicester, they had to consider how far they could relieve the old sewers of the town of storm-water. The deep sewers, which had been laid down by Mr. Wicksteed in 1854, had become much too small, and had consequently more work to do than they could perform; they laboured further under this disadvantage—that when the pumping engines were overpowered, which occurred very frequently in wet weather, the sewage had to back up to a height of about 9 feet, before it could discharge into the river; which meant nothing else than transforming the system of sewers into a subterranean lake at almost every ordinary shower of rain. It was therefore absolutely necessary, to provide a remedy. The question that had to be considered was; whether they should retain the old deep sewers for the sewage only and relieve them of the rainwater, or whether they should construct new sewers altogether, to take both the rainwater and the sewage, with frequent storm overflows. In one district of the town the separate system has been carried out so far as it was thought advisable; there were duplicate sewers in all streets, but the house drainage had not been re-modelled, and consequently the storm-water sewers received the rain falling on the surface of the streets, and only in a few cases that falling on the front part of the roofs. To re-model, the drainage of

every house would have involved too great an outlay, from about 10*l.* to 15*l.* per house, to say nothing about the inconvenience to the inhabitants. In this district they had careful gaugings taken, and found that only 33 per cent. of the total rainfall went to the storm-sewers, the rest going to gorge the deep foul sewers. With such facts before them, it would have been mere folly to extend the separate system, and they decided to recommend the authorities to construct entirely new sewers, which were now being carried out. They had divided the town into various high and low-level districts with one main intercepting sewer to each, which joined at its lower end the main outfall sewer to the pumping station. Each district had its separate storm overflow, calculated to discharge ¼ inch of rainfall per hour over the area of the district, which meant practically a capacity of ½ inch of rainfall per hour, on the assumption that only 50 per cent. of the total fall reach the sewers. In dry weather, the main outfall sewage conveyed the sewage to the pumping station, where it was lifted on to a large sewage farm; but in wet weather the rain-water would flow forward in two main storm outfall culverts to a point some 4 miles below Leicester, where the levels admitted of a free outfall. These main storm-outfalls were calculated to take a rainfall of 2 inches in 24 hours over the whole area of the town. All the storm-outfalls were connected by solid weirs with their main intercepting sewers, the cills of which were fixed at such a level as the circumstances of the case required, and only when the waters had risen to this height could they leap the weir and flow forward in the storm overflows. Such an arrangement insured that the foulest liquid, which was generally poured into the sewers at the commencement of each storm, must go forward to the pumping station, and could not reach an open watercourse. No general rule could be laid down concerning the separate system. What might be right in one case might be wrong in another, as every case required to be dealt with on its particular merits.

Mr. Buchan said that prevention was better than cure. Cholera had been the scourge of nations, and he believed, in the opinion of some medical men, India was perhaps the original seat of cholera. Cholera was due to disease, and those who believed in the germ theory as the origin of disease must insist upon the destruction of these germs at their source. Consequently, the paper read by Mr. Baldwin Latham was worthy of their serious consideration in that respect, as insisting upon better sanitation in India. He understood, from various sources of information, that of late years the French had been following the English system, which was a matter of credit to English engineers. In most towns the "separate" system would involve too much expense; and also the effect of preventing rain-water from going into the drain, which carried off the soil deposits, would be, he thought, a step in the wrong direction. More especially would that be the case on account of the law, which he thought was a very bad law, enacted in London and in many other cities, limiting the flush in water-closets to a couple of gallons. The value of water-carriage for sewage as being so much better than any other system was now a matter beyond discussion.

Mr. A. Mault, replying to the questions that had been asked by Mr. Anderson of Melbourne, said that it was not simply the question of economy that induced him to use iron pipes for drainage, rather than wood; it was, also, because of his experience of wooden drains since he had been in the colony. There was a very great difficulty in keeping wooden

drains clean. The soap and grease, especially from kitchens, adhered to the surface of wood in a way in which it did not adhere to the surface of iron. In addition to that, there would certainly be the question of feasibility. It was utterly impossible to get earthenware pipes there. If they had imported earthenware pipes from Hobart they would have been very lucky if they got one pipe in ten delivered on the ground whole. The enormous weight of the pipes in comparison with wrought-iron was also important. As to the question of cost, the sizes used were 9-inch, 6-inch, and for house drains, 4-inch. The 9-inch pipes cost complete at Hobart on shipboard, 1*s.* 1*d.* per foot run. The 6-inch pipes cost 9*d.*, and the 4-inch 7*d.*; and the cost of carriage exactly doubled that by the time they arrived at Zeeban. As to durability, he had seen drain pipes that had been used for 14 years, and were as good at the end of the 14 years as they were at the beginning. Mr. Thomson of Edinburgh mentioned that he had known pipes not coated with asphalt that had been in use for 40 years; but, as the President had mentioned, the question of durability of course would greatly depend upon what duty they had to perform. If iron pipes had to drain chemical works they would not last long, but with ordinary sewage he agreed with what fell from Mr. Thomson, that its action—especially that of the grease and soapsuds—had rather a preservative effect than the contrary upon the duration of iron pipes. There was another matter special to the subject that he had mentioned, namely, that even supposing iron pipes did not last long, if they were the cheapest, an engineer who had to face the question of the drainage of a mining settlement was usually quite justified in using them, if they would last only six years. At the end of that time a mining settlement either became a large, important, and wealthy community, or it became a desert. If it became a desert the pipes might wear out if they liked; if it became an important and wealthy community they might very well afford to re-organise their system of drainage.

Mr. Baldwin Latham, in reply, said that it had been stated that a water-closet was no doubt the cleanest sanitary appliance that could be used; but for some reason or other it was supposed not to be applicable to Eastern countries. He could assure the members, from the examination of the working of water-closets in Eastern countries, that there was no appliance so well adapted for an Eastern country as a water-closet. The inhabitants of India, the Hindoos, always used water in large quantities after defæcation, and, therefore, there was no system so well adapted for carrying away fæcal matter as the water-closet system. Even in a climate like India, where the atmospheric conditions were such that very rapid drying would take place, it did not pay to manufacture sewage into *poudrette.* In Bombay, Calcutta, and other large towns where they had water-supplies, all the public latrines which were used by the natives were upon the water-closet system, and these were the only appliances which were anything like sweet in India. They answered admirably, and the Calcutta Municipality had been extending them into the private courtyards attached to the native residences, so that it was now quite a common thing to see a whole row of latrines worked upon something like the trough system, which answered admirably for the purpose, and nothing was better and sweeter. The contrast with the system hitherto in operation where only the solid matters were collected, leaving the liquids to flow away in the street gutters, was something very surprising to those who had any noses. With regard to river pollution, no doubt the rivers did free themselves to an enormous extent from any dangerous

pollution. Take, for instance, the case of the Ganges. The Ganges, of course, was a large river; it was a long river; it was a river with a very considerable flow, liable to enormous fluctuation in its flow, but also liable to extraordinary pollution. Not only did the drainage of towns more or less find its way into it, but every person dying of cholera was thrown into it, every person dying of small-pox was thrown into it, every unmarried person under 12 years of age was thrown into it, all the religious ascetics who died were thrown into it, and the ashes of all the dead were thrown into it after burning, but the burning often was a mere farce. He had himself seen bodies floating down the Ganges with the two feet burned off, and the hair on the head not even singed, so that the enormous amount of pollution which passed into the Ganges was certainly some test of the nature of the power of a river for self-purification; because at the mouth of that river, from one of its branches—the Hoogly—Calcutta took its water-supply, and Calcutta since the introduction of this water-supply had been more free than many other parts of India from cholera and other such-like epidemics. They had there an exemplification of the enormous purifying power which nature had provided in the flow of a river. But if they went a step further, even to their own country, they found this remarkable fact, that taking towns of like character and like population, those which were supplied from rivers had the lowest rate of mortality; in fact, the great city in which they were at present assembled was a case in point, for although the water of the Thames was still liable, more or less, to receive the pollution of a considerable population, yet there was no city in the world which would compare with London in regard to its standard of health. Sewage farms, no doubt, were an admirable way of getting rid of sewage, and it was suggested that only farms with porous soils could be used for that purpose. He would like to point out that many of the chief farms in the country, which had been in operation for over a quarter of a century, were on clay soils, and yet they as perfectly purified the sewage to-day as on the first day when the sewage was applied. He might particularly note the towns of South Norwood, Doncaster, Warwick, and Rugby, where the farms were upon the stiffest clay that could be found anywhere. In some of those towns the sewage of as much as 300 people had been applied per acre, and successfully purified. With reference to the separate system, he thought some misunderstanding had arisen. In his own practice he never had yet drained a town in which the whole of the rainfall of the district went into the sewers. In the case of a town which had already got a system of sewers in operation, but which needed a new system in order to deal properly with the sewage, the best thing to do in such a case was to retain the old sewers, as was suggested, and to make use of them for the purpose of the rainfall, or the larger part of it, leaving the new system of sewers to deal with that portion of the rainfall which could not conveniently be excluded from the sewers. Even when the rain was excluded from sewers, there was an enormous fluctuation in the flow, and he might refer to a series of tables which were published by the Thames Sewage Discharge Commission. Those tables showed the daily observations of the quantity of sewage flowing through the sewers, the rate at which the rain fell, and the degree to which it affected the sewers. He found that on one occasion, when only 0·1 inch of rain was recorded in the day—it fell in a limited time,—it actually increased the mean flow in the sewers by 5·9 times. That was in a district in which there was a separate system. On another occasion only 0·25 was recorded

in the day, but fell in a very limited time, and that increased the mean rate of flow 5·7 times. It was found, by observing the rate at which the rain fell, that the average fall in the whole of those four years was at the rate of ·065 inch per hour, or if it continued at that rate for 24 hours the average rate was a little over 1½ inch per day. This, of course, affected the sewers to this extent in a district in which there was a separate system. Generally, in English towns, the roof area was at the rate of about 200 people to the acre, but it still gave an enormous fluctuation in the amount of rain when that water had to be dealt with in the sewers. It was, therefore, necessary to make provision for these large fluctuating quantities in any system of sewerage, especially where pumping came into operation. A suggestion had also been made with regard to the system of overflows, that the rain-water should overflow and go to the natural streams when the sewers got to a certain extent over-charged. He had carried out works of that character in the town of Longton, where there was that abominable system inaugurated years ago of building houses back to back, with no yard between them, where all the slops and everything was thrown out into the street. In such a case the only possible way of dealing with drainage was by means of one system of sewers, and the system was so arranged that with a very small dribble of sewage it flowed down the ordinary sewer and went into the foul sewer, but when the rain came in large quantities it leaped over the opening which was provided for the sewage proper, and passed away direct to the streams of the district. That system had been in operation for over 20 years, and with the most perfect success. No complaint had ever been made with regard to the fouling of the streams in the neighbourhood, so that the suggestions which had been made had really got their practical exemplification in this country at the present moment. As to the Liernur system, which he had thoroughly investigated, it was not a system which would guard rivers entirely from pollution. The Liernur system only dealt with one part of the sewage, and therefore there was still greater liability under that system of river pollution. As to automatic pumping of air and water, mentioned by Colonel Jones, all he wished to say was that none of those objections which were mentioned by Colonel Jones did arise. The water which was used for the transmission of power was never allowed to pass into the sewers; or if it was, it was only used for the purpose of flushing the sewers, and so saved other water which would otherwise be used for that purpose. Wooden sewers were very largely used in America. They were very successfully used in the drainage of Boston, especially in the case of roads in which the ground had been recently filled up above the low levels of the district. Those sewers had been built as large wooden barrels, with a view that when settlement had taken place, ultimately their interior should be lined with brickwork in the ordinary way.

Mr. D. Balfour, M.Inst., C.E., F.G.S., (Newcastle on-Tyne), in reference to sewage disposal considered land-schemes, either by broad irrigation or intermittent filtration, to be generally most efficient and economical, wherever both properly designed and managed. Surface-water generally should be kept separate from the sewage, rendering less land necessary in accordance with the sanitary maxim, "the rainfall to the river, and the sewage to the soil." Moreover, all sewage work should be kept in the hands of the local authority, as letting to a tenant is always found to result in deterioration and dissatisfaction. Chemical

schemes, with or without land, should only be resorted to for exceptional local conditions.

Mr. Lemon said he wished to say a few words in reply to the French engineer, Mr. Bechmann. He regretted that he (Mr. Lemon) could not follow his observations as clearly as he could have done if they had been in his own tongue, but he understood Mr. Bechmann to say that what he had called the French system was not the French system now. No one was more glad to hear that statement than himself. What he had written in his paper was the result not of mere second-hand information, but of his own personal observation. He had seen towns in France where what was called the tinette—that was a tub in which they put the solid excreta—was placed in the roof of the house. He had seen that overflow, and in one house he went into, a fair sized house, the inhabitants were obliged to throw the excreta on to the roof of an adjoining house. Anything tending more to produce a high rate of mortality than that he did not know. With regard to what was called the *tout à l'égout* he had used the term in contradistinction to the old French way of conveying away solid matter in carts, and allowing the liquid to find its way into the sewers. What a French engineer meant by *tout à l'égout* was the removal of all the excreta and foul water from the houses to the sewer. That was no doubt coming into operation in France, and France was very eminently indebted to that eminent engineer, M. Duranclaye, for the very excellent change which had taken place in the sanitation of France.

Mr. Baldwin Latham said he should like to make one explanation. It had been pointed out to him that in Calcutta none of the bodies were thrown into the river, that the municipality saw that they were not so thrown in. He (Mr. Latham) was speaking of districts above Calcutta, and not of those which were within the jurisdiction of the Calcutta Municipality.

Professor Pacchiotti said one of the speakers had referred to Rome. Rome had one system of sewerage which had prevailed for 2,500 years, and had been worked without any difficulty, and with very great success. What the Italian Government was doing now was a new thing, and it was this: instead of sending the drainage into the river, it would before long be sent to the Campagna, in order to get rid of malaria, and to get rid of the bad soil. Sewage farms had been spoken of. At Milan, for 300 years, they had worked a sewage farm successfully. Paris was a little behind in some respects. In Paris there were still 80,000 cess-pits, holes at the bottom of the houses where sewage matters were kept for five or six months in a year and then taken away by carts.

Professor D. van Overbeck de Meÿer said he was rather afraid he should throw an apple of discord into the meeting, but he could not pass silently the different conclusions which had been reached that morning. He was really opposed to them all, and if he was not asking too much of their patience he would give his opinion in the form of the following conclusions. The *tout à l'égout* and the separate system were noxious in the town itself, because (1) proper ventilation of sewers was impossible so long as the houses were different in height, and the street openings, manholes, &c., were not abolished; (2) the *tout à l'égout* was a fiction wherever the storm-water was admitted in the sewers, because overflows could not be avoided; (3) it was impossible to get rid in a proper way of the deposit in the sewers; (4) the danger to health

lurked not in all parts of the house refuse, but in the fæcal matters only; (5) the diminution of the death-rate in sewered towns was not due to the *tout à l'égout*, but to the supply of good water and to other sanitary improvements which were the necessary and therefore constant forerunners of a sewerage system; (6) the best existing system was the Liernur system, the only good system from a sanitary point of view.

Sewer Ventilation.

BY

W. Santo Crimp, Mem. Inst. C.E., F.G.S., &c.

There is probably no subject in connexion with sanitary science regarding which more has been written, but fewer experiments made, than the ventilation of sewers. The question is undoubtedly one of extreme difficulty, as the conditions vary in almost every sewer, and one would therefore have thought that writers would have at least made an attempt to ascertain the actual conditions prevailing before proposing methods that would in all likelihood fail in consequence of their being designed upon wrong principles. In nearly every paper or work on the subject examined by the author, the writer has assumed that temperature is practically the only agent causing movements of sewer-air, an assumption greatly wanting in basis, as we shall see later on.

As a result of this assumption, it has been widely believed that sewer-air constantly passes from the lower parts of a drainage system to the higher, to the discomfort of the inhabitants of the higher parts of the district sewered. As a matter of fact, the sewer-air as often passes downhill as the reverse way.

Having constructed some works in connexion with the ventilation of sewers, which were designed in accordance with the views then prevailing, the author was disappointed with the results, and he determined to undertake an extended series of observations on the movements of sewer-air. This he did during the year 1888, and the results were communicated to the Institution of Civil Engineers, and may be found in Vol. XCVII. Experiments were made continuously for a year in one 12-inch sewer, having a gradient of 1 in 8 to 1 in 100. The sewer was trapped off from the main into which it discharged, and an air-inlet was provided at the upper end of the syphon trap, whilst at the end of the sewer, 1,860 feet distant, a 6-inch ventilating pipe was carried above the roof of a building near. Two anemometers were placed in the sewer, together with two self-registering thermometers, and these were read daily.

The temperature of the sewage was lowest in February, when the average was 44·75° Fahr.; that of the sewer-air was lowest in March, when the average was 42·0°; the highest temperatures were of the

sewage 56·70° in September, and of the sewer-air 57·75° in August. The month of February was the coldest month, the mean temperature of the atmosphere being 34·75, whilst August was the warmest, the mean temperature being 59·10°. The greatest difference between the temperature of the sewer-air and that of the atmosphere was during October, when it averaged 8·40°, the sewer-air being the warmer; on one day, the 8th, the difference was equal to 16·5°, and this was the greatest variation registered.

Now, if temperature were effective in causing movements of sewer-air, we have sufficient data to enable us to calculate the number of times the air in the experimental sewer would have been changed, say, during the month of October, using the fundamental formula relating to falling bodies $v = \sqrt{2gh}$: but, as a matter of fact, up-hill currents in the sewer were only measurable by an anemometer on three days, whilst down-hill currents prevailed on 12 days.

These experiments had not been continued very long before the author found that for all practicable purposes the wind was the only agent producing movements of sewer-air that could be measured by an anemometer. Not only were experiments made in ordinary sewers, but also in surface-water sewers, at a time when they contained no water, and precisely the same results were obtained as in the sewers proper. Having, therefore, ascertained the true cause of the movements of sewer-air, their direction and strength could, after some little experience, be fairly well foretold, so far as the experimental sewer was concerned; for when northerly winds prevailed the sewer-air travelled up hill, and when southerly winds were experienced the sewer-air passed down hill. In other sewers that were being experimented upon at the same time the opposite conditions prevailed; and this is easily explained, for in passing over a town the course of the wind is broken up and deflected, and it will affect the openings upon the sewers in different ways, in some cases inducing currents out of them, in others passing down into the sewers and driving out the sewer-air elsewhere.

On taking charge of a part of the enormous main drainage system of the Metropolis, the author soon found opportunities of ascertaining the conditions prevailing, and he found that they were identical with those in the smaller sewers at Wimbledon; light air and calms mean stagnation in the sewers, whilst brisk winds cause rapid movements of the sewer-air. Of course an abnormal rise of temperature due to the admission into the sewers of hot liquids will produce a local disturbance, but this in nowise affects the main question.

The author ventures to formulate his views in the subjoined summary:—(1.) That the wind is the only agent which produces measurable movements of sewer-air in an ordinary system of sewers. (2.) That the fullest use of the wind should be made in effecting the proper ventilation of sewers. (3.) That the offensiveness of sewer-air should be lessened to the fullest practicable extent by systematic flushing and cleansing of the sewers and by keeping them structurally in a thoroughly effective condition. (4.) That small pipe-sewers need not be ventilated

to the same extent as those large enough to admit of men working in them, vents high overhead being alone required. (5.) That in all systems where practicable, ventilating pipes should be carried up high buildings or other objects, where they may discharge their foul contents into the atmosphere high overhead, and that street ventilators should then be reduced to a minimum. (6.) That if every house were properly drained and proof against sewer-air, ventilation of sewers, as ordinarily practised, would be unnecessary.

Sewer and Drain Ventilation.

BY

R. READ, Assoc. M.I.C.E., M.S.I., City Surveyor, Gloucester.

Introduction.—A system of drains and sewers consists of a number of lengths, or branches, of underground pipes, of gradually increasing diameter and varying gradients, converging towards the lowest point or outfall of the system, where the sewage, more or less diluted, is discharged by gravitation.

The drains are the units of the system, and their total length is largely in excess of that of the sewers, to which they are connected.

The great majority of drains and sewers in a town consist of glazed stoneware pipes, and the remainder of brick or concrete culverts.

The flow through the drains is intermittent, but a sufficient number are always in use together to keep a continuous stream flowing through the sewers, but varying, both in volume and velocity, with the time of day, the amount of water supply, and rainfall.

The fluctuations in the volume of sewage are frequent, the maximum flow in dry weather occurring between 9 a.m. and 2 p.m., when about half the daily water supply of a town passes into the sewers; but rain may cause a sudden or gradual increase at any time.

Sewer always full.—The remaining space above the sewage in a drain or sewer is always filled with air, watery vapour, or gas, or a mixture of at least two out of the three.

Minimum Velocity.—In a sewer running half full, a minimum velocity of 180 feet per minute is necessary to prevent the deposit of solid sewage, unless special means of flushing are adopted to prevent it; but this velocity will discharge sewage at the outfall from any part of a town long before decomposition can take place.

When solid deposit occurs in any drain or sewer, decomposition quickly ensues, and sewer gas, as distinguished from sewer air, is produced in increasing quantity, until the obstruction is removed.

Compression and Expansion.—Sewer air is alternately compressed and expanded against the crown of the sewer by the rise and fall of the sewage, and also by the increase and decrease in barometric pressure; the latter action is particularly observable before a storm.

Watery vapour is constantly given off from the surface of the sewage as from any other wet surface in contact with air; and both the watery vapour, and sewer gases, if any are present, diffuse themselves throughout the sewer air until the point of saturation is reached in an unventilated sewer; the percentage of moisture in the sewer air is lowered by ventilation, and the more perfect the ventilation the nearer the sewer air compares with the outer air.

Temperature.—The temperature of sewage and of sewer air is generally lower than that of the outer air during the summer, and higher during the winter.

Forces at work.—Motions of sewer air are produced by compression, expansion, diffusion, differences of temperature, and barometric pressure; these motions cannot be measured by the anemometer, but are made visible by the condensing of the watery vapour in cold weather, or by the introduction of smoke.

Down-hill Currents.—A velocity of 180 feet per minute in the sewage will generally carry the sewer air down-hill with it, and the motion is accelerated by every intermittent discharge from the drains.

Wind.—The most powerful agent in producing motion in the sewer air is the wind, which acts by inducing a vacuum in, or by blowing directly into, any opening in the sewers or drains, according to the position of the opening, and the direction and force of the wind.

Unventilated Sewers.—All attempts to keep sewer air and gas bottled up within the sewers and drains having failed, ventilation was reluctantly adopted, for want of something better; and it is now a generally recognised fact that unless some provision is made to ventilate sewers and drains, they will ventilate themselves in a dangerous manner.

Earliest Ventilation.—The first ventilation was most probably unintentional, by untrapped rain-water pipes, and by overflow pipes from rain-water cisterns becoming untrapped in dry weather, and allowing the passage of sewer gas into houses.

Street Gratings.—To relieve the pressure upon the sewers and drains, manholes, at long distances apart, were ventilated by open gratings at the street level, and these have been gradually increased in number and area of openings, on the assumption that the nearer the approach to an open trench the better; and now they are placed from 40 to 200 yards apart, and the openings range from 30 square inches to 72 square inches area.

This method of ventilation by gratings at the street level only, simply provides overflows, or safety valves, to prevent too great an accumulation of gas: but it is vent only, without ventilation, as the movements of the sewer air are very slow, feeble, and uncertain, unless there is a good wind, a rising barometer, and a fast running stream of sewage.

The difference in height between any pair of adjacent gratings at the street level is generally so small that there is no marked tendency for either to become an inlet, in preference to an outlet, and puffs of wind may make them act feebly both ways, within a few seconds, without greatly affecting the air within the sewer.

With a falling barometer the watery vapour and sewer air acting by expansion and diffusion rise out of the street gratings, and should there be decomposing deposit in the sewer, or in any drain connected with it, a nuisance will be apparent, for which the gratings will be blamed, although they only call attention to the existence of defects which they did not cause and can only partially remedy.

Shafts above Roofs with Street Gratings closed.—In consequence of complaints, the street gratings in some towns have been closed, and iron pipes, erected against buildings substituted. This is still vent only, without ventilation, and a reproduction of the action of the street gratings at a higher level, without dealing with the first cause of the nuisance.

Partial Ventilation.—Neither of the above systems of venting to relieve internal pressure by partial ventilation, inducing a mere tendency to vacuum in the mouths of a number of outlets, whether at the street level or above the roofs, can be anything more than a manufactory of gas, the currents of air having no power to penetrate far beyond the mouths of the openings. At intervals, however, discharges of gas must take place, and the longer the interval the more dangerous the gas becomes.

The constantly changing conditions under which a system of sewers and drains act are such, that it is as impossible to stop at partial ventilation, as it is to have no ventilation at all.

Comparison with a Mine.—The leading idea which for a long period governed attempts to ventilate sewers, was, that it was a similar problem to the ventilation of mines, whereas the conditions are entirely different. In a mine, all the air entering the down-cast shaft must traverse the workings and pass out through the up-cast shaft, these being the only two possible openings. But any attempt to draw air through a sewer will not be felt at a greater distance than 400 yards, and only under very favourable conditions will the distance exceed 100 or 200 yards. This was conclusively proved in 1858, by Sir J. Bazalgette and Col. Heywood, by experiments on a large scale, with a furnace at the Westminster clock tower.

Wimbledon.—More recently, in 1887–8, Mr. Santo Crimp, at Wimbledon, had 600 yards of 12-inch sewer trapped off at the lower end, an opening, 28 inches area was made at the street level, just above the trap, and a 6-inch opening at the upper end, all other known openings being closed. There was 100 feet difference of level between the two openings, and a fan attached to the upper one, drew air from the sewer at the rate of 300 cubic feet per minute for 14 hours, and during the same period the sewer air continuously discharged itself from the lower opening 600 yards away at a velocity of 42 lineal feet to 104 lineal feet

1 p. 2205.

per minute, thus showing that one or more accidental openings must have existed, and that the friction of the flow of sewage, and the effect of the wind, was sufficient to bring the sewer air down to the lower opening, in spite of the powerful fan at work at the upper end.

On removing the fan the 6-inch pipe was carried up a building 25 feet high, and anemometers attached to the lower opening showed that during 1888 the air current was down hill at that point on 273 days and up-hill on 97 days. Unfortunately no anemometer appears to have been used at the shaft at the upper end.

Notwithstanding these facts, the favourite recommendation by newspaper correspondents has always been to connect to a factory chimney, on the assumption that it will entirely clear a whole system of sewers, and cremate the gases. Factory chimneys are usually confined to one quarter of a town, and although velocities from 500 feet to 2,000 feet per minute can be obtained by connecting to them—and in some towns costly stacks 100 feet high have been specially erected for the purpose—their effect upon ordinary sewers is only local, and very limited in extent; so that it is like shooting at a sparrow with a 100-ton gun.

Keeling's "Destructor."—The most recent apparatus for ventilating sewers by artificial means is "Keeling's patent sewer gas destructor," an arrangement of lamp column with a 6-inch connexion from the sewer for passing sewer air through an atmospheric gas-burner fixed in the base of the column, the outlet being about 10 feet above ground, under an ordinary street gas-lamp, placed at the top of the column; a consumption of coal gas from 6 cubic feet to 10 cubic feet per hour is required to keep them burning, and produces a heat of about 600° F. at the burner, and about 100° F. at the outlet, where the velocity is about 200 feet per minute, or equal to about 40 cubic feet per minute of air extracted.

The advantages claimed for this apparatus are that sewer gas is entirely cremated, and that one destructor will suffice to ventilate fabulous lengths of 12-inch sewer, variously stated, or inferred, as somewhere between 1,000 yards and nine miles; but no such distances can be affected by any such apparatus if a fan or a factory chimney of 10 times the power cannot do it.

The apparatus cost about 15*l.* fixed complete, and about 10*l.* per annum for gas, and is a useful luxury as an aid to natural ventilation if properly applied at the lower end of a sewer, instead of at the upper end, as recommended by the patentee.

Their greatest use is for dealing with the emanations from a very foul sewer; but this is treating the symptoms of the disease, instead of the disease itself, for such a sewer requires re-construction first, and ventilation afterwards.

True Ventilation.—Nearly all attempts to maintain a constant current of air flowing in one direction have failed, because they have not been in harmony with the forces at work within and without the sewers. The streets are the only places where municipal authorities are free to ventilate sewers as they please; therefore, the gratings at the street

level have always been more numerous than shafts above the houses; and as long as this is the case, no constant current of air inwards at the street gratings can be maintained. There can be no true ventilation without a system of both inlets and outlets; the street gratings should be comparatively small to always act as inlets, and the outlets should always be above the roofs of the houses, and much more numerous than the inlets. It is necessary, therefore, in order to give a strong initial velocity at the inlets, and to localise the ventilation, that the street grating inlets should not exceed 30 or 36 square inches area, placed from 60 to 100 yards apart, and that the outlets should be distributed over these lengths in such numbers of 4-inch or 6-inch shafts that the sum of their sectional areas, between each pair of inlets, shall exceed the sectional area of the sewer as much as possible.

This arrangement can only be obtained by terminating every house drain by a 4-inch soil-pipe, or 6-inch shaft, carried above the roof as an outlet, with no obstruction between it and the sewer; the fresh air will then constantly enter at every street grating, with a minimum velocity of 100 to 200 feet per minute, travel down the sewer with the sewage, and up every drain and outlet pipe or shaft above the roofs. Each length of 60 or 100 yards of sewer between a pair of inlet gratings, and all the drains connected therewith, will then be thoroughly ventilated by a localised continuous current which cannot be reversed, and which will require no traps, flaps, valves, or other obstructions, except at the gullies and w.c.'s, to isolate or direct its course; the velocity of the current will only increase with the wind, from whatever quarter it may blow, and sewer gas will have no chance of existence.

Interceptors.—The above system requires the abolition of the so-called "Interceptor" traps, which obstruct the flow of the sewage, and render the true ventilation of the sewers impossible. They are the only form of unventilated syphon trap now tolerated, and oppose the inertia of about three gallons of stagnant sewage to each discharge through the drain; this sewage in the "Interceptor" never gets entirely changed, and is constantly manufacturing gas on its own account and providing a greater danger to the inhabitants of the house than the sewer to which the drain so trapped is connected.

Flushing.—Every w.c. should be provided with a mechanical apparatus, or cistern, for flushing after each user, to keep the drains properly clean in the intervals between rainfall, because the water so applied must of necessity pass through both drains and sewers, while whatever the quantity of water used by the municipal authorities for sewer flushing it can only pass through the sewers, leaving the drains untouched, and thus wasting a large quantity of water which would be more usefully and economically employed if passed through the drains as well as the sewers.

Object of Ventilation.—The true object of sewer ventilation is not to let out at intervals quantities of sewer gas of increasing foulness, but to introduce into properly constructed sewers and drains

such a constant current of air, as will prevent the formation of gas altogether.

The systems of partial ventilation now in use, merely provide sufficient oxygen to facilitate the formation of gaseous compounds, without rendering them harmless.

The Better Ventilation of Town Sewers.

BY

W. D. CARÖE, M.A. Cantab., F.R.I.B.A.

The following paper took shape in an inquiry, at the instance of the Grosvenor Estate Board, into the possibility of supplementing in some manner the present system of ventilating the sewers by means of open grids at the street level, so as to mitigate the complaints constantly directed against the open grid ventilators. In forming conclusions from such an inquiry it was essential to admit no theories, however attractive, which had not been verified by practical tests, but to base every argument for remedial measures upon the solid foundation of past results and wide experiences.

The general system of rendering pipes for the conveyance of sewage refuse innocuous to the inhabitants of cities or districts—the system of open or ventilated drains and sewers—is now so thoroughly accepted in principle by sanitary experts, and the laws relating to the action of sewer-gases themselves, and of fresh air admitted into open sewers to dilute them are so well ascertained and available, that it would demand excuse rather than apology to enter into fundamental explanations of the open system, or to propose discussion upon the authenticated principles of the dilution and diffusion of sewer-gas.

In an unwavering acceptance of the open system, I conceive, nevertheless, that every sanitary expert should take note of the singular conditions which rule Bristol (population, 221,665), where the city engineer is to be found congratulating the Council upon the principles of the "Open system" being violated in every essential particular, and the medical officer claiming an almost complete immunity from diseases having their origin in sewer-gas emanations,* and imploringly asking his committee to pause before they make any such changes in the sewer non-ventilation as will reduce his city "to the level of other towns."

Believing, however, that the case of Bristol is exceptional on account of the large amount of water readily available without cost for flushing purposes, and the great difference of levels in the several parts of the city and suburbs; and, even so, that the conclusions reached

* Report, 1884.

by the advisers to the Bristol authorities are not to be accepted without question, I assume the advantage of the completed open system, even if applied to Bristol. I am, however, prepared to admit that (given the very essential requisite of *perfect* house drainage) the present disgraceful emanations from the street ventilators and gullies (of, for instance, the Chelsea and Fulham end of the Metropolitan Northern low-level sewer), form a strong argument in favour of closed sewers as opposed to those ventilated by open grids only, and a pernicious example of the failure of what I venture to call the incomplete system.

I will now briefly postulate:—1. Ventilation as applied to sewers properly means the *Dilution* and *Diffusion* of sewer-gases to such an extent as to render them innocuous and inoffensive. (Sewer-gas is to be prevented from forming in any quantity, and that which must of necessity be given off is to be dispersed in the most diluted state possible.) 2. The effective agents of Dilution are fresh air, deodorising chemicals, and an adequate supply of water for flushing. 3. The effective agent of Dispersion is *fresh air* only. And I will add as an axiom:—

Inlet and outlet ventilators are equally important, and these should be at different levels.

I will base my inquiry upon the above statements, all of which are admitted to be axiomatic in connexion with house drainage. I believe, however, that the importance and value of deodorising chemicals and water-flushing are thoroughly recognised by our authorities, and although not used to the utmost as yet, no efforts are being spared to extend their use. The last depends, of course, upon the exigencies of water supply, about which there is ample stir at present.

I confine myself, therefore, in the main to the consideration of the atmosphere as a diluter and diffuser.

It is surely a matter of common sense that where the same openings have to act as both ingress and egress ventilators, the system must be inadequate. It generally happens that open grids become a greater nuisance when there are not enough of them; in other words, that the process of dilution is insufficiently operative. In the metropolis there is no uniformity or system in this respect; and it would be, doubtless, well as a preliminary, if the proper spacing of such ventilators were made compulsory.

I believe it will be undisputed that, on account of the numerous inlets, apart altogether from open grids, sewers cannot be treated by the same simple systems of ventilation as mines; and that, given open grids, special supplementary shafts at intervals—aided by fans or furnaces or extractors in which gas is the agent employed—have been tried with more or less efficiency, but have generally been found insufficiently operative to justify the cost of either their erection or maintenance. In place of any such non-automatic arrangements, I would here advocate the completion of the open grid system by a multiplicity of special shafts having *egress* at a high level complimentary to the low-level *ingress* of the open grids. Special shafts of this nature are generally known as *Pipe Ventilators.*

I urge not only that this system has common sense upon its side, and is the system likely to prove finally effective, but that it has the most reliable authorities and experience already amply in its support to justify its adoption where possible. Here it is necessary for me to meet an objection which has been, and doubtless will be, urged against the system *per se*, and which can be urged, though not with equal force, against the ordinary system of house drainage, since it is regulated virtually by the same principles. The system depends upon differences of temperature between the external atmosphere and that of the sewers. It follows from the statistics of sewer temperature, that on certain summer days the pipe ventilators become inoperative. But are we then in a worse position than if the pipe ventilators did not exist? They themselves, if inoperative, will be inoffensive; and if there is pressure in the sewers it will only find its way out as it does at present at the readiest egress outlet—the street grids. This is the time specially when we should fall back upon our other means of dilution—deodorising chemicals and ample flushing.

But there is a great difficulty to meet which is not inherent to the system. I allude to the question of owners' or occupiers' prejudices. Unfortunately the sense of the average householder is not "common" in his own interests, and at present his consent has to be obtained to the pipe ventilators being carried up his premises; and compulsory legislation, however salutary, would be undoubtedly difficult to obtain. This is a matter of the greatest importance because it has to be insisted that the system is not carried out efficiently by the erection of an odd ventilating shaft here and there, but by numerous shafts acting in conjunction. We thus find that one local body condemns pipe ventilators because it has erected one shaft and found it ineffective. Another erects an isolated shaft at a considerable elevation, which proves such a nuisance that it has to be removed. A multiplicity of the pipe ventilators being essential to the success of the system, it follows, therefore, that the difficulty of obtaining householders' consent constitutes the first obstacle to be overcome in its application, and it would at present seem practically impossible to apply the system in districts already built upon. As an example of this difficulty, the Commissioners of Sewers of the City of London lately resolved that in all instances of the erection of new houses the owners should be treated with to this end, but within 12 months not a solitary instance of consent had been secured.

In new districts, however, or upon large properties under one ownership, where there is a large area of rebuilding, or where new streets are formed, there would seem to be no such difficulty if the freeholder or authority were to make the adoption of the system part and parcel of the building contracts. It is to be borne in mind that the system of shafts in any given area will always work in connexion with the nearest open grids within that area, and will not carry off the gases from sewers at any great distances even although these be not adequately ventilated. In recommending the adoption of the open grid system, Sir Robert Rawlinson points out that while the air in one mile of street sewer may be taken at 1,000 cubic yards, the air in the street above

would be approximately 500,000 cubic yards changed and renewed many times in the day, so that the air in the sewer will be several million times less in comparative volume than the air in the street, and the dilution of any sewer-gas will be in the same proportion. By the addition of pipe ventilators, the open grids which, without this supplement, are acting as both inlets for fresh and outlets for foul air, become active fresh air inlets, excepting only in certain conditions of the atmosphere referred to. The sewer-gas would generally become thus further diluted, and the amount of it dispersed through each of the many shafts proposed would be practically unnoticeable.

Before discussing the practical application of the system a few statistics of existing pipe ventilators may be useful. The metropolis is behindhand in this respect, possessing over its whole "greater" area only 582. In 12 districts they are stated to be satisfactory, but in the bulk the number may be said to be quite insufficient to rely upon for results of the successful adoption of the system. Coventry has 1,500 pipe ventilators, while other provincial towns have many more than London, and a much smaller area, of course, to deal with.

Blackpool seems to be the solitary exception where owners' prejudices have been overcome and no difficulty experienced in erecting shafts up the houses, and in answer to the query as to the means of ventilation employed, the surveyor is in the position to reply "By open "grids in streets, by shafts up house gables, by five street lamp "vents, and four 40-feet shafts used for electric lighting, and sundry "chimneys." He further adds his opinion "that very frequent open "grids in the streets are part of the proper system of ventilation, but "these are of no use unless counter shafts be placed to extract foul air, "and the grids become inlets."

The city engineer of Liverpool informs me that he has 900 pipe ventilators in use, and has had no complaints. I need not multiply instances however, but merely state that wherever the system has been tried to an even moderate extent (for in no instance has it yet been adequately adopted) it is spoken well of.

I will now briefly remark upon the practical construction of these pipe ventilators recommended. The vestry of St. Pancras being strongly in favour of the adoption of the system (whereby they state that probably no gas would ever be generated or accumulate to such a degree as to become offensive or perceptible) advocate its application thus:—Each main house drain should not be disconnected from the sewer, but each branch house drain should be disconnected from the main house drain and the latter carried up to a high point as a ventilator to the sewer.* This arrangement would secure, undoubtedly, the same principle of sewer ventilation, but it might in many cases lead to such difficulties and complications in systems of house drainage and ventilation that it is not to be lightly recommended.

Sir Robert Rawlinson and others assume that the best arrangement is to connect the pipe ventilators with the crown of the sewer, and

* Metropolitan Board of Works Report as to Cleansing and Ventilation of Sewers, 1886.

thence conduct them up the fronts of the houses. But here again the greatest advantages of the system are not obtained. The construction should be as follows:—Each tenement having the usual disconnecting trap and chamber serving to cut off the sewer from the house drain, and at the same time acting as an inlet for fresh air to the whole system of house drains, every separate branch discharge into this chamber being carried up to the roof full-bore as a ventilator to that branch; at the back of the disconnecting trap (that is, on the sewer side) there should be a junction, and at this point the pipe ventilator should be connected, and thence carried up to the house-top, being disposed as will be hereafter suggested. By this arrangement two great advantages are secured: (1.) A current of air is constantly introduced through the short length of pipe between the disconnecting trap and the junction of the house drain with the main sewer, preventing it from forming, as by the usual arrangement, a dead or stagnant length in which sewer-gas can accumulate. (2.) The breaking of the water-seal of the trap by siphoning or pressure is rendered impossible. This latter point is of the utmost importance. If, whether by excessive rainfall or by flushing with large and sudden quantities of water, the sewage rises in the main sewer so as to cover the whole of the orifice by which the house drainage enters it, the water-seal of the disconnecting trap is apt to be broken. A broken water-seal means, of course, the possibility of the main sewer discharging its sewer air or gas in close proximity to the lower windows of a town house.

If every house is to have such a shaft as that recommended, its *disposition* becomes a matter of importance. It is an advantage that the shaft should rise vertically from its connexion with the drain as soon as possible, and have as few bends as possible. There can be no doubt but that the best position for the shaft is up the front of the house. The open end should be removed from windows and chimneys as far as can be.

As regards the size of the shafts, inasmuch as a 6-inch drain is employed to carry off the output from very large houses, or even large blocks of flats, it may be said generally that, with a pipe at every tenement, none need be larger than 6 inches, and probably 4 inches would be found ample. This, however, is a matter of calculation, as the collective area of outlets in any district should be fully equal to the area of inlets formed by the open grids in that district.

However much appearance may have to give way to practical or sanitary considerations, it is appalling to think of the possible effect of a series of 6-inch or 4-inch pipe ventilators up the front of each tenement, a forest of fresh ugliness vieing with the tall-boys which already so disfigure our skylines. But fortunately both artistic and sanitary considerations can be fully regarded. In many cases the fortunate favour with which gables towards the street front are now being regarded comes to the aid of the architect. There can be no better place for the discharge of a pipe ventilator than the apex of a gable, which fact indeed adds another point in favour of this treatment, so that the picturesque and the sanitary go hand in hand in this case.

The pipe, in which there can be no pressure, can be carried up either in the core of the wall or in one of the many projecting pilasters or architectural features at present so much in vogue. It can discharge either by a finial at the apex of the gable constructed on purpose, or at the back of the coping. There is no architectural difficulty whatever. Where, however, there is no gable, it can be built in the party-wall as suggested by the City of London authorities, and undoubtedly this arrangement overcomes the difficulty which might arise from the varied height of street buildings. But even where there is no gable and the party-wall is impossible in a new building, it is merely a matter of the exercise of ingenuity on the part of the architect to conceal the eyesore, than which many more difficult problems will arise for solution in almost every day of his practice.

Cases may arise, especially if an owner's prejudice can be overcome and a pipe ventilator added to an existing house, where it is impossible, or may be considered too unsightly, to erect it on the façade. It may be insisted that there is no serious objection to its being carried under or through the house and up the back. It will not act quite so freely in this case, but it will act freely enough, just as a ventilating pipe to a house drain does, which always takes the same course. The suggestion of the St. Pancras Vestry, already alluded to, embodies this arrangement of conducting the sewer-air under the house of necessity, as in almost every town-house drains under the basement are essential. A dry pipe, with no pressure within it, laid by the side of the house drain can have no reasonable objection urged against it.

I summarise as follows:—

1. That the system of open grids in the streets, supplemented by shafts from the sewer side of every disconnecting trap upon the main house drains, be recognised as the effective automatic means of sewer ventilation, and its adoption be aimed at in all possible cases.
2. That it be made compulsory over new areas of building, or over large areas of rebuilding.
3. That the flushing and deodorisation of sewers be made compulsory, and in new districts that the former be part of the charters of the water-company.
4. That the vestries be called upon to exercise rigidly their statutory powers, not only in respect of new drains, but in respect of existing drains; also to adequately ventilate the dead ends of all drains.

The adoption of the system as suggested in new districts, or in large areas of rebuilding, would be a fitting stepping-stone,—and possibly the only one—to its spreading by the force of example and success to the older parts of our great towns.

I cannot better conclude than with the words of the Vestry of Tooting Graveney, who, in a well-considered memorial to the Metropolitan Board upon the subject, say, that " several persons have had " shafts from the sewers carried up the sides of their houses at their

" own expense, which have answered in their immediate neighbourhood, " but to be successful the scheme should be general." And they go so far as to suggest that parliamentary powers should be obtained.

DISCUSSION.

Dr. T. W. Hime (Bradford) said the subject was one of very great importance. It was one not less associated, at all events, with the craft which he himself practised than it was with that of engineering, and it was one which he might say had at the present time been so unfruitfully cultivated that it was worth while venturing to say a word or two about it. Although it was unfruitfully cultivated in the main, he particularly wished to except from that remark the admirable paper just read by Mr. Crimp, a paper so essentially opposed to the ordinary views, and to the classic statements which one met with in all works upon the subject of sewerage and sanitation, beginning with the official volumes of their own Government and going down to the humbler handbooks. With regard to the contents of sewers which were to be ventilated, perhaps a word might be said. He had heard, and he generally heard when he came to places where there were discussions of sewers and sewage, a great deal about sewer-gas. He might be pardoned the heresy of saying that there was no such thing in existence as a special sewer-gas. The gaseous contents of a sewer were a mixture of gases of a highly complicated and highly composite character. There was one thing which it was tacitly assumed was contained in the so-called sewer-air or sewer gas, and that was the germs of disease. From the first time when a disease germ was identified up to the present date, he believed there was no authentic record of the disease germ of any kind having ever been found in sewer-air. He had himself aspirated hundreds of gallons of sewer-air, and had drawn it through a material specially manufactured for the purpose of cultivating these disease germs, but never had he recognised one of them. Some exceedingly valuable experiments on this subject were made by the late and too early dead professor of chemistry in Aberdeen, in which he showed that, so far as living organic constituents were concerned, the gaseous contents of the sewers of Aberdeen were very much better than the ordinary atmospheric air around. The same thing had been proved over and over again in Germany, the home of bacteriology; and he might say that these disease germs were things which were as well known and as easily recognised by those who had studied the subject as the ordinary botanical or zoological living specimens on a larger scale. It ought to be taken at once as a fact, and recollected, that never yet had these organisms been found in sewer-air, or at any time got from it. Now it was, of course, very satisfactory to be able to say, " Oh, yes, here is a case of typhoid fever in the house, and we know there is a hole in " the pipe; the virus has come out through the hole, and it has caused " disease and death in the house." Then they simply set the sanitary inspectors and engineers to work, which was exceedingly gratifying. It was much pleasanter to do all this than to be obliged to say, " I have not the remotest idea where the typhoid fever has come from," but that was the fact. It was well that that should be recognised, because

the statement as to specific diseases coming in this way from sewer-gas from the sewers was a very dangerous statement, and it was one which must obscure the truth, and lead right away from the direction in which they ought to go. With regard to the character and flow of gases and vapours in the sewers, Mr. Crimp had given some exceedingly valuable facts, and he (Dr. Hime) could verify them from some experiments of his own, made on a large scale in the years 1882-83. It was a fact that they just as often found the gaseous contents of sewers going downhill as uphill, and it was not a fact, by any means, that because the sewer-air was generally warmer than the external air, therefore it was always rising up to the top, and escaped from the highest point of the sewer. Ought they not, instead of wasting their time in talking about non-existent disease-germs in the gaseous contents of their sewers, to see that their houses were in no way connected with the sewers? He did not wish to maintain that because they could not find the organisms of diphtheria and cholera in sewer-air that therefore sewer-air was advantageous and wholesome. Certainly not. He imagined that the proper way to connect houses with sewers was to disconnect them absolutely, so that there might be no possibility of sewer-air getting into the house at all. Rather a serious heresy had been mentioned, viz., that the only dangerous part of the outflow material and waste of their houses was the excrement. He need only draw attention for one moment to the fact that the most fearful disease, the most awful scourge of humanity as well as of our most valuable animals, was tuberculosis; and that undoubtedly the main source of infection from tuberculosis was not from the intestinal excretions, but from the sputa. Then again, another disease which caused a great deal of alarm, but very few deaths, was diphtheria, and it was perfectly certain that the virus of diphtheria never did come out of man's nether vent, but only from the opposite extremity. The cholera-bacillus died quickly in sewage. The dangers from sewer-air were of a different character. Sewer-air must be kept out of their houses undoubtedly, but it was not with the view of excluding such specific causes of disease, because they did not really exist in the sewer-air, and consequently no system of sewer ventilation would ever succeed in getting them out.

Mr. Stephen Holman said he happened to be the unfortunate individual who had been connected with Keeling's system of ventilating sewers mentioned by Mr. Read. Dealing first with Mr. Crimp's very able paper, he (Mr. Holman) knew that the statistics he had placed before them might be taken as correct, as taken by anemometer registration, but how the pipes which were to be run up to the high altitude of a house, and so on, were to conduct the foul air from the sewers into the atmosphere at low temperatures was a mystery. In his experience, in introducing a system for the extraction of sewer-air by means of heat, extending over some three or four years past, one which was in use in such towns as Ealing, Richmond, Winchester, and Reading, with very great mechanical results, whatever the chemical results might be, he had gone into the matter merely as an engineer and not as a chemist. On account of some controversy which arose at Ealing some few years ago, Dr. Russell, Analytical Chemist of St. Bartholomew's Hospital, was called in to make tests and to give a report. In that report it was stated:—"The second "class of experiments were to determine whether the micro-organisms "or germs known to be abundant in sewer air are destroyed by the heat-"ing process carried on in this ventilation. To determine this I drew air "from the top of the ventilator by means of an aspirator for 13 minutes

"through sterilised cotton wool. This wool was carefully introduced "into a flask containing a cultivating medium, and an exactly similar "experiment was made with air from the sewer. After four days the "flasks, which had been kept at a temperature most favourable for "stimulating growth, were examined. In the one which had the wool "through which the sewer air had been drawn, there were at least 7,000 "distinct colonies or growths. Two experiments with air from the top "of the ventilator were made (that is, after the gas had passed through a "destructive heat,) and one gave only six colonies, the other 14. That is "a strong illustration of how efficiently organisms are destroyed by the "method of heating used in this form of destruction." Whether sewer air contained germs which were assumed to be fever germs; whether the air contained germs, or otherwise, might be a chemical question, which he would rather leave to Dr. Russell to determine; but it was a common experience that frequent complaints were made of sewer emanations. Whether they were dangerous or otherwise, they were certainly offensive, and with all their means of trying to prevent the inlet of sewer gas or air into their dwellings, they were nevertheless most offensive when they were emitted in the streets, especially in the midst of dense populations such as were found in their various cities and towns. The system which had been introduced in the towns he had named was that of gas furnaces placed in columns in the streets, standing 10 or 12 feet high, and by the consumption of 8 feet of gas every hour they got through from 2,500 to 3,000 cubic feet of sewer air per hour. The air which would come through the gas furnace undoubtedly would be the lightest sewer-air. Marsh gas was something like half the weight of atmospheric air, whilst carbonic acid gas would be half as heavy again as atmospheric air. Where a destructor or ventilator of that class was in operation, it would extract not the heavy air, but the light air, which came always to the surface. With regard to the means of ventilation by iron pipes up buildings, they were undoubtedly, as Mr. Crimp had suggested, inlets of air under certain conditions of temperature. If there was a prevailing temperature at the surface of 30 degrees and in the sewers of 50 degrees, or if it was 20 degrees colder on the surface than in the sewer—under those conditions air would not come up the sewer through the pipes, but would go down through the pipes. If air was moving only five or six miles an hour it would be found that an iron pipe was a very great refrigerator, a very cooling surface, much cooler than the air in the sewer or in the man-hole in the street, because the iron pipe was often three-eighths or half an inch thick; therefore those pipes became inducts of fresh air or surface air to the sewers, and, as Mr. Crimp had very justly said, when they had inlets of fresh air to the sewers some of the sewer gas must go out. He would give as an instance Croydon, which had a severe epidemic of scarlet fever in 1886–87. Iron ventilators had been put up in large numbers since that time, he was told to the extent of 300. What had been the result during the last year? Last winter, in 1890, they had the most severe epidemic of diphtheria of any town in England. They certainly had had 150 cases, three persons dying in one house. Those 300 iron pipes had not saved Croydon from that epidemic. He had had conversations with doctors in many localities, and they informed him almost invariably that throat diseases were most prevalent amongst persons living opposite to those open gratings in the streets. Sewer air could be dealt with before it reached the outer air, and it should be so dealt with, by passing it through a disinfecting medium, and the best

medium of which he knew was fire. In Richmond, four years ago, the authorities were often threatened with litigation because of the offensive emanations from the streets, but if they went to Richmond to-day they would find something like 12 or 15 of those destructors in use, and there were no complaints of sewer emanations there. It was the same at Ealing. If sewer gas was not infectious, why all this anxiety to keep it out of their houses? Was it simply because it was offensive and smelt? Surely not!

Mr. H. A. Roechling (Leicester) referred to the experiments which had been made at Munich, where it was found that the wind had no noticeable effect upon the movement of sewer-air; that the air in the sewers oftener flowed downhill than uphill; and that the cause of the downhill movement was the rush of sewage, which bore the air with it. The observers did not agree on the question of the influence exerted by the difference in the temperature between the atmospheric air and that within the sewers. The gentleman who conducted his observations during the winter months found that this temperature-difference did cause movements of air within the sewers; whereas the gentleman who was at work during the summer months came to the conclusion that this difference had little to do with the movements of sewer-air. He mentioned this to show that Mr. Crimp's chief conclusion, that the wind practically was the only cause of the movements of sewer-air, was not supported by the Munich observations. He would also quote an observation made in this country. Mr. Haldane of Dundee, who some time ago examined the question of the composition of the air within sewers, recorded some observations made on the flow of the air in the Bristol sewers. The Bristol sewers were not ventilated at all, and there were only two places, close to the outlets, where the sewers could be entered without digging. In one of them, close to the Clifton Suspension Bridge, which Mr. Haldane entered, he found that the flow of the air was downhill. Wind could have had no influence upon the sewer-air in this case, as the Bristol sewers were not ventilated; and, as Mr. Haldane remarked that there was a rapid flow of sewage, it was much more likely that this rapid flow bore the air with it downhill. He had quoted these cases, as he was of opinion that it was not wise to form general conclusions from what had been observed in a particular locality and under particular circumstances. There were no two systems of sewerage in every respect alike; in fact, every sewer in every town had its own conditions, under which it had to work. He would like to ask the question, of what did the air of sewers really consist? It had been proved by Prof. Koch, of Berlin, that the air of a sewer was much purer than the air in the street immediately above the road surface. From 50 to 60 litres of sewer-air contained only frem one to two germs, whereas a much larger number of germs was contained in street-air close above the pavement. The higher up they went into the air from this point, the less became the number of microbes present. Prof. Koch's statement was even better than the figures deduced by Mr. Haldane, who stated that he had found that the air of some sewers in this country, upon which he had experimented, contained from 10 to 12 germs per litre. He, too, had come to the conclusion that it was, as a rule, the outside air which contaminated the sewer-air with micro-organisms. In Leicester they ventilated, in 1881 and the following years, an old system of sewers; and shortly afterwards complaints were raised about the smells coming through the open grids at the

street level. The late Mr. Joseph Gordon, who was then borough surveyor of Leicester, had asked him to ascertain from the returns of the Medical Officer of Health what had been the death-rates of Leicester since the ventilation of the sewers. He had prepared tables and a diagram, in which he had graphically shown the relation existing between the death-rates from various causes during the six years prior to the ventilation and during the six years after its introduction. It could be seen that since the systematic ventilation the following reductions had taken place in the various death-rates; typhoid fever had gone down 49 per cent., measles 48 per cent., diphtheria 30 per cent., diarrhæa 23 per cent., scarlet fever 18 per cent., phthisis 17 per cent., whooping cough 15 per cent. The death-rate from the combined seven principal zymotics had decreased 26 per cent., and that from all causes 11 per cent. Before the ventilation of the sewers they had no unpleasant smells in the streets, but higher death-rates than they had after the ventilation of the sewers, when complaints of bad smells in the streets became frequent. He did not say that the ventilation of the sewers had done all this, but he would put the reverse. Was it possible that, if sewer-gas was really as poisonous as it had been stated to be, an improved sanitary condition would result after admitting the gas in large quantities into every street? He could only come to this conclusion, considering all the circumstance of the case, that sewer-gas, if poisonous at all, lost its power of mischief when mixed with large volumes of atmospheric air; and that, as as Dr. Hine had so well remarked, it hed a mystic effect upon the sentiment of the people, causing them to attribute to it all manners of disease. After all, it was really not so much a question of the ventilation of the sewers as a question of the designing of them. If the sewers were designed with self-cleansing velocities, then nothing that could create a smell would be deposited in them. Where the ground was so flat that they could not get self-cleansing gradients, they would have to assist nature, either by mechanical means—to some of which Mr. Middleton had referred in his paper—or by systematically cleaning out the sewers by hand, as was done successfully on a very large scale at Berlin. When they had clean sewers there would be no complaints of foul smells arising from them.

Mr. Baldwin Latham believed that there was no connexion whatever between the outbreak of diphtheria which occurred in Croydon last autumn and sewer ventilation. It did not occur in the districts where these ventilating pipes had been put up, and it was traced by the Medical Officer of Health to a milk-supply, which not only affected Croydon, but also another district outside, from which that particular milk-supply came. They might therefore disabuse their minds of the idea that the erection of ventilation pipes had anything to do with the outbreak of diphtheria which had been mentioned as being due to the erection of these 300 pipes put up in the case of Croydon. For himself he believed that a great deal too much stress was thrown upon this question of ventilation. He thought, with Prof. Attfield, that if they allowed large volumes of pure air to pass through a sewer in contact with sewage they had large volumes of foul air escaping at some point, and that the great secret in sewer ventilation was not to encourage these currents of air through sewers, but to give such an amount of vent as should prevent any pressure of air being exercised upon the traps of their houses, so as not to allow any escape into the house itself.

Prof. D. van Overbeck de Meÿer wished to say a word with regard to the objections raised to his statements. He explained that, in

speaking of fæcal matters, he meant excrementitious matters emanating from the human body. That was what he ought to have said. Secondly, he had to point out that not only were the germs in the sewer-air noxious, but there were gases that were still more noxious. The experiments of bacteriologists were not of very great value, because the conditions under which they were made were not always equally favourable. If they worked with different aëroscopes, using six or eight different instruments, and compared the results, they would find the greatest difference in them. He spoke from experience, and if anyone would make the same experiments, he would get the same results. His first point was that the difference in the results was very great. The second point was, they could not be quite sure of discovering the different pathogenic germs in sewer-air, and that also was a very great point. Finally, he must say to those who had spoken of sewer-air that it was not the germs only they had to deal with, but there were also chemical substances which they did not know at present, noxious substances, so that they must be very cautious in their conclusions. They, therefore, could not say at all that sewer-gas as it existed in the sewers was quite innoxious; on the contrary, it had the noxious property of preparing the body for the action of pathogenic germs. That was stated by different physicians in Germany, Belgium, France, and also in Holland.

The Chairman (Prof. Robinson) said it had been pointed out that sewer-gas was practically harmless, that, in fact, it was so free from impurity one would almost feel inclined to think, instead of leaving town for the benefit of one's health at this time of the year, it would be better to take advantage of some open drain or sewer, and spend the recess there. As far as his own feeling was concerned, he was not prepared to accept that state of things, but he should continue in his own professional practice to exclude sewer-gas from the houses of those whom he had to advise.

Mr. Santo Crimp said that, after all, the question of the movement of sewer-air was one of fact, and could be tested in 10 minutes by going into a sewer. He should be most happy to conduct any number of the members into some of the London sewers on the following day, and if it was windy he promised that they would hardly be able to carry the candles with which they would be provided. If, on the other hand, it was a calm day, the currents would be found to be very feeble indeed. He recently walked down one of the large sewers from Oxford Street to Buckingham Palace, and found that for some considerable distance the sewer air was travelling downhill. At first sight it appeared to be carried along by the sewage, as had been mentioned with regard to the Munich sewers; but the air was travelling a good deal faster than the sewage. It was quite clear, therefore, the sewage could not have been dragging the air in that instance. Some little distance down the sewer they came to a place where the side of the sewer had been removed to form a storm overflow. The sewer-air was all going over it, and not only was the air passing down the sewer going over it, but the air also coming up the sewer from below the storm-water culvert was all going over the overflow, as shown by the smoke, and passing along the storm culvert, which contained absolutely no water whatever. It was impossible to avoid the conclusion in that case, that the wind was really the motive power which was causing this sewer-air to move. Bristol had been referred to as showing the slight connexion there was between sewer ventilation and

the death-rate. From the return tabulated by the Registrar-General, he found that in the decade 1870–80 the zymotic death-rate in Bristol was the lowest of that of the large towns tabulated, with the exception of Brighton, and in Bristol the sewers were absolutely unventilated, whilst at Brighton they were most fully ventilated. He ventured to think, therefore, that the connexion between the ventilation of sewers and the death-rate was one of very slight importance indeed. Mr. Holman's difficulty as to stagnation in cold weather was easily got over if they once recognised that wind really caused movement of sewer-air.

Mr. R. Read said he agreed very far with Mr. Santo Crimp as to the wind being a most powerful agent in producing motion in sewer-gas, but it was not the only cause; although the smaller causes, such as temperature, diffusion, and expansion were not in themselves very strong, still, when they acted with the wind, they assisted it, and the flow of sewage down the sewer certainly did carry the sewer- air with it. He had made a number of experiments; in one case, in a 12-inch sewer with a gradient of 1 in 28, he put smoke rockets into the sewer at a street ventilator with their fuzes pointing up the sewer, but persistently in all cases the smoke appeared at the ventilator below, and did not go up the sewer at all. Even when a fresh wind was blowing up the street in the direction of the rise of the sewer, the smoke would persistently follow the sewage downhill. In the case of which he had shown a diagram of a sewer, commencing at the lower end with a gradient of 1 in 154 from the first manhole to the next lamphole above, and of 1 in 224 up to the second lamphole, there was no air going into the first manhole and the intermediate lamphole, but a strong in-current into the manhole at the upper end. That was caused by 10 ventilating shafts, one on a telegraph pole and one to each of the nine houses. They were 4-inch pipes, having an outlet of 12 5 square inches each, the aggregate being 125 square inches of outlet. There was always a sufficient draught from the wind blowing over the tops of those ventilator-shafts to produce an in-current at the upper manhole with an average velocity of 123 feet per minute; a very slight wind, running 250 feet per minute at the tops of the ventilator-shafts, would produce that velocity. The average velocity at the outlet, multiplied by the sum of their areas, equalled the velocity entering the manhole multiplied by the sectional area of the air-space of the sewer. When those conditions were obtained there was invariably an in-current at the upper, or second, manhole only, and an out-current at all the shafts below it. He never got any other direction of current at all in that length of sewer. The houses erected were new houses, and the shafts were added as the houses were built, and it was not until he got that proportion of outlets to inlets that he obtained a constant current of air following the sewage downhill. Before that happened the current could be reversed, but not now, the outlet ventilators being in excess of the inlet. The other part of the sewer was on a new road with very few houses upon it. Therefore the street ventilators, which were upon the usual system of 60 to 100 yards apart, with 36 square inches of opening, were simply overflows; they might act as inlets or outlets, just as a puff of wind might make them, and the same below. But this length of 113 yards of 12-inch sewer, isolated simply by those shafts, showed always a current going in, down, and out of it. As to the temperature that Mr. Holman mentioned, the effects of that temperature had been overcome by wind. If the temperature happened to be in favour of the wind so much the better, but if it was against the wind,

the wind would beat it. Mr. Holman had somewhat misunderstood him; he did not mean to say that his sewer-gas destructor was a bad thing at all. He thought it was a very good one, but it was very expensive, and the borough engineer who had to face the ratepayers could not afford many of them.

Assainissement des Villes: Traitement des Eaux d'Egout par les Procédés Agricoles.

PAR

M. AIMÉ BONNA.

L'assainissement des villes, sous l'heureuse impulsion des Comités d'hygiène, est actuellement l'objet des légitimes préoccupations des municipalités.

La création de distributions d'eau et la construction de réseaux d'égouts pour recueillir et évacuer toutes les eaux impures ou usées, constituent l'assainissement intérieur des villes; celui-ci doit se compléter par l'assainissement extérieur, c'est à dire par le traitement des eaux d'égout avant leur déversement dans les cours d'eau dont la pollution va toujours en augmentant.

Je me restreindrai, dans cet exposé, à ce dernier point du vue spécial, c'est-à-dire à l'assainissement des cours d'eau et à l'utilisation des eaux vannes.

La question de l'épuration des eaux d'égout a donné lieu à de nombreuses discussions sur le meilleur système à adopter; mais si des divergences se sont présentées sur les conditions dans lesquelles l'épuration devait se faire pour donner des résultats avantageux, les hygiénistes paraissent aujourd'hui d'accord pour reconnaître que l'emploi agricole est le seul qui permette, par la filtration lente à travers le sol, d'obtenir une oxydation parfaite des matières organiques, et le plus efficace pour ramener les eaux à un état de pureté satisfaisant, tout en utilisant les matières fertilisantes qu'elles renferment.

En France, de louables efforts sont tentés pour obtenir l'assainissement intérieur et extérieur des villes, et l'application faite à Reims par la "Compagnie des Eaux Vannes" de l'épuration par le sol, permet d'apprécier les résultats qui peuvent être obtenus par les villes avec le concours de l'industrie privée, pour assurer, non seulement l'épuration des eaux d'égout, mais encore l'utilisation, sur de grandes superficies, de leurs principes fertilisants.

Il ne parait pas utile d'entrer dans des développements sur les études et discussions qui ont précédé la conclusion du traité passé entre la Ville de Reims et la Compagnie des Eaux Vannes pour l'épuration de la totalité des Eaux d'égout.

Les travaux d'adduction et de distribution, commencés, à la fin de l'année 1887, aussitôt après l'approbation du traité de concession par

l'autorité supérieure ont pu être terminés dans le courant de l'année 1889, quelque temps avant la visite des membres du Congrès international d'Hygiène qui eut lieu le 7 Août de la même année.

Pour bien définir les opérations de la Compagnie des Eaux Vannes à Reims, je crois devoir exposer, d'une manière sommaire, les travaux d'irrigation et les améliorations foncières qu'elle a entrepris.

Le réseau des égouts de Reims se devise en deux zones ayant chacune une égout collecteur spécial pour l'adduction des eaux aux champs d'épuration. Les eaux du collecteur supérieur se déversent sur les terrains par simple gravitation, tandis que celles du collecteur inférieur sont relevées en partie par les pompes pour l'irrigation des terrains hauts du domaine de Baslieux.

L'Usine élévatoire se compose de 3 machines indépendantes, d'une force totale de 110 chevaux, capables de refouler, chaque jour, la totalité des eaux d'égout du collecteur inférieur, dont une partie se déverse en temps ordinaire sue les terrains bas du Domaine.

Le service des irrigations se devise également en 3 zones :

La zone supérieure, dont le réseau de distribution d'une longueur totale de 9,200 m., est composé de tuyaux en fonte des diamètres de 0 m. 600., 0 m. 400, et 0 m. 300 ;

La zone moyenne, avec conduites en béton de ciment de 0 m. 800, 0 m. 600, 0 m. 400, et 0 m. 300 de diamètre, répresentant une longueur totale de 8,500 mètres ;

Enfin, la zone inférieure, dont le réseau de distribution, principalement composé de conduites à ciel ouvert, a une longueur totale de 10,000 mètres.

Le drainage pour l'écoulement des eaux de colature a été obtenu par le creusement de grands canaux d'assainissment à ciel ouvert d'une longueur totale de 12,000 mètres.

Des jaugeages effectuès pendant l'année 1890, il résulte que le cube moyen débite par les collecteurs a été de 35,717 m³ par jour, soit 12,635 m. cubes débités par l'aqueduc supérieur et 23,094 cubes par l'aqueduc inférieur ; c'est en moyenne un volume de 0.m³400 par tête d'habitant.

Le chiffre de 35,717 m³ est une moyenne journalière ; il varie suivant le temps, les saisons, les jours ouvrables ou fériés, et aussi suivant les heures de la journée. La moyenne du débit dans la journée est d'environ 28,000 m. cubes, et la nuit de 8,000 m. cubes, en nombres ronds.

On conçoit la complexité que présentent les eaux d'égout au point de vue de leur composition. D'après les analyses faites par le Bureau municipal d'hygiène de Reims, les eaux contiennent en moyenne par mètre cube, au moment où elles arrivent aux bassins de réception.

AQUEDUC SUPERIEUR.

Matières en suspension	minérales	0.k498	1.k121
	organiques	0.623	
Matières en dissolution	minérales	0.652	1.k012
	organiques	0.360	
Total des matières fixes			2.k133

Azote total, par mètre cube			0,g091
se décomposant :			
en azote ammoniacal	0.g050	0.091	
et en azote organique	0.041		
Chlore			0.g406
Acide phosphorique			0.015

AQUEDUC INFERIEUR.

Matières en suspension	minérales	0.g566	0.g927
	organiques	0.361	
Matières en dissolution	minérales	0.152	0.564
	organiques	0.412	
Total des matières fixes :			1.g491
Azote total, par mètre cube			0.g050
Azote ammoniacal	0.g032	0.050	
Azote organique	0.018		
Chlore			0.g0543

Les eaux d'égout de Reims, notamment celles de l'aqueduc supérieur formées en grande partie des eaux résiduaires des peignages de laine sont chargées en matières organiques et azotées et susceptibles d'entrer en fermentation. D'autre part, les éléments utiles à l'agriculture se trouvent réunis dans des proportions comparables à celles que présente le fumier de ferme, ce qui en fait un engrais complet. Ces eaux résiduaires contiennent, en outre, beaucoup de potasse. La potasse est l'engrais complémentaire par excellence des terrains crayeux, et l'efficacité de tous les autres dépend de la plus ou moins grande abondance de cet engrais dans le sol.

Les 2 kgs environ que tient en suspension chacun des 36,000 m. cubes amenés chaque jour aux champs d'épuration représentent, par 24 heures, 72,000 kgs, soit 72 m. cubes, et, pour l'année entiére, 26,000 m. cubes environ de matières solides, minérales et organiques.

L'eau d'égout traitée par un sol perméable comme à Reims est complètment épurée. Voici l'analyse d'un échantillon d'eau pris dans le canal d'assainissement de la Compagnie des Eaux Vannes, à proximité de la ferme de Baslieux :

Degré hydrotimétrique	total	19°2
	après ébullition	3°5
Volume de permangante de potasse décoloré par un litre d'eau :		21 c.c.³
Matières organiques correspondantes exprimées en acide oxalique par litre :		0.g01323
Acide nitrique AzO^5		0.00686
Ammoniaque libre AzH^3		0.000054
Ammoniaque organique		0.0001

Le but poursuivi par la Compagnie des Eaux Vannes, tout en assurant l'épuration des eaux, est de faire de l'utilisation agricole sur de grandes superficies.

L'irrigation à forte dose, lorsque l'on ne se préoccupe exclusivement que de l'épuration, exige des précautions dans la distribution des eaux ;

l'utilisation, au contraire, sur de grandes surfaces, permet de répartir le nombre et la durée des arrosages, d'adopter une méthode d'assolement dans les cultures.

Pour ne pas être astreint à des travaux de drainage trop onéreux, il convient de choisir pour l'épuration des eaux d'égout, des terrains possédant une épaisseur filtrante suffisante ; il faut également tenir compte de leur configuration géologique et topographique. Le choix de ces terrains présente quelques difficultés, car on ne trouve pas toujours à proximité des villes, des superficies assez considérables pour faire de l'utilisation agricole ; cependant les terrains que peuvent être drainés, aérés et amendés sont aptes à l'irrigation. Si la perméabilité du sol laisse à désirer, il convient d'étendre les surfaces, afin de rendre l'opération praticable en modérant méthodiquement les doses d'arrosage.

Le drainage des terrains, indépendamment de l'assainissement du sol, peut avoir encore son utilité, notamment s'il y a lieu d'éviter le déversement des eaux de colature dans un cours d'eau, ou à proximité de sources servant à l'alimentation de villes. Les eaux de drainage seront dans ce cas, dérivées de leur direction normale pour être dirigées vers un autre cours d'eau.

A Reims, le choix de la Compagnie s'est porté sur les terres qui entourent les domaines de Baslieux et des Maretz dont l'épaisseur de la couches filtrante est supérieure à 2 mètres.

Ces terrains sont formés, pour la plus grande partie, de terres calcaires, formant le sol arable de tous les environs de Reims et de la Champagne. Le carbonate de chaux y domine dans une proportion de 80 °/₀ environ ; le sable silicieux représente 15 °/₀ : l'argile 5 °/₀ au plus avec un peu d'humus. Ces terres ont des pentes généralement modérées facilitant la distribution des eaux d'irrigation.

Le champs d'irrigation sont, d'ailleurs, parfaitement situés, par leur éloignement suffisant des centres habités, et parce qu'en raison de leur position, ils permettent d'évacuer directement à la Vesle les eaux épurées, sans que l'on ait à craindre, pour les communes voisines, le relèvement de la nappe d'eau.

Parmi les terrains faisant partie des domaines achetés par la Compagnie des Eaux Vannes, se trouvent quelques prés-marais formant, principalement sur la rive droite, les bords de la Vesle. La Compagnie a entrepris l'amélioration foncière de ces terrains de mauvaise qualité, de nature un peu tourbeuse, et par conséquent acides. Elle est arrivée à les rendre, pour la plupart, propos à la culture.

La première opération à effectuer était l'assainissement des ces prés afin d'abaisser la nappe d'eau dans cette partie de la vallée. Pour y parvenir, la Compagnie s'est renduea equéreur de 2 moulins situées en aval, " Macô et Compensé ; " le premier disposant d'une chute de 0m. 80 ; le second, de 1 m. 00. Elle a exécuté, sur une longuer totale de 12 kilomètres, un large canal d'assèchement latéral à la Vesle et un canal d'assainissement traversant tout le domaine dans sa plus grande longueur pour recevoir les eaux épurées provenant des irrigations.

Ces travaux ont transformé complètement des marais absolument incultes, et ont donné à ces prés inondés autrefois la plus grande partie

de l'année, une épaisseur filtrante suffisante pour l'utilisation agricole des eaux d'égout.

En même temps que l'on poursuivait l'assainissement, des dispositions étaient prises pour améliorer le sol. Certaines parties étaient rechargées après défoncement, avec des déblais calcaires provenant des fossés d'assainissement; d'autres recevaient des phosphates naturels; le reste, non encore complètement préparé, recevra des scories de déphosphoration, environ 6,000 kgs. à l'hectare.

La ville de Reims a mis à la disposition de la Compagnie des Eaux Vannes 160 hectares destinés à servir de champs d'épuration, ci. -	160 Ha.
La Compagnie, de son coté, a acheté le domaine de Baslieux, le château des Maretz et ses dépendances, ainsi que les terrains avoisinants jusqu'au hameau de Macô, le tout représentant une superficie de - - - -	425 „
dont 55 hectares de terrains non irrigables, composés d'un château, d'un parc, de deux étangs et des abords immédiats du chateau.	
Ensemble - - -	585 Ha.

Les irrigations ont lieu au moyen de rigoles de distribution à ciel ouvert. Les rigoles principales desservent les rigoles secondaires, qui alimentent, à leur tour les billons séparant les planches cultivées et disposées de façon à eviter la submersion et à permettre à l'eau d'égout de circuler autant que possible sans toucher les plantes.

Les travaux de préparation des billons se font économiquement au moyen d'instruments agricoles spéciaux. Ces instruments, à traction de chevaux ou de boeufs, sont composés de billonneurs pour le creusement de la rigole et sa régularisation.

Le volume journalier des eaux d'égout est approximativement de 36.000 m. cubes pour une superficie irrigable de 520 hectares, ce qui représente une dose moyenne d'irrigation de 25,265 m. cubes par hectare et par an.

Les arrosages reviennent plus ou moins souvent, suivant la nature des cultures et suivant les saisons. Les expériences ont démontré que les arrosages à l'eau d'égout ne sont nullement préjudiciables au point de vue de la richesse des plantes. La seule précaution à observer consiste à susp ndre les arrosages trois ou quatre mois avant la récolte, en ce qui concerne notamment les betteraves à sucre, afin que la végétation ne soit pas poussée trop avant dans la saison et ne retarde pas la maturité de la plante.

Les terrains crayeux consument rapidement les engrais; il convient donc de les leur donner par faibles doses souvent répétées. Les irrigations à l'eau d'égout conviennent, d'ailleurs, admirablement à cette nature de terrain.

Si l'on fait de l'utilisation agricole, il faut disposer l'assolement de manière à pouvoir irriguer certaines cultures au moment où les arrosages doivent cesser sur d'autres parties.

La culture maraichère, celle de la batterave et des autres plantes sarclées, conviennent bien pour les terrains arrosés à l'eau d'égout. Ces cultures laissent le sol libre l'hiver, permettent en cette saison les irrigations et même de légers colmatages ; en outre, les binages multiples ont pour résultat de rompre la croute superficielle du sol entre les lignes, d'enlever les mauvaises herbes, d'assurer l'accès de l'air entre les plantes, et de maintenir la perméabilité des terrains.

La culture profonde, indispensable pour la betterave, est exécutée à Reims d'une manière complète et régulière au moyen d'un appareil de labour à vapeur. Par le mouvement rapide de l'instrument, la terre est mieux soulevée et devient plus meuble en se désagrégeant. L'incorporation des dépôts au sol se fait plus intimement, et au point de vue de l'épuration, le sol se trouve mieux aéré, ce qui facilite la combustion des matières organiques.

La culture en billons, faite avec les instruments spéciaux dont il a été parlé ci-dessus, donne d'excellents résultats, tant au point de vue des travaux de préparation que des façons subséquentes, binages et arrachages.

L'emploi de vannettes mobiles en tôle galvanisée permet également de diriger les eaux avec la plus grande facilité ; on peut augmenter ou modérer les doses suivant les besoins de chaque récolte.

Les résultats, pour la première année d'exploitation normale, ont été très encourageants. La récolte de betteraves à sucre a été notamment remarquable en 1890, car elle a donné une moyenne de 45,000 kgs à l'hectare, avec une densité supérieur à 6 %.

Malheureusement, ces résultats ont été en grande partie compromis par les gelées de l'automne qui ont eu lieu avant l'arrachage complet de la récolte et avant la livraison aux usines.

La Compagnie, pour plus de certitude dans ses résultats au point de vue de la richesse saccharine des betteraves, avait employé, comme engrais complémentaires et à titre d'essai, des superphosphates et des phosphates de la Meuse. La récolte a démontré qu'en irriguant d'une manière méthodique, on pouvait obtenir des produits d'une densité élevée avec un poids bien supérieur à celui obtenu dans les cultures intensives du Nord de la France.

Nous sommes convaincus que le rendement atteindra prochainement 60,000 kgs en moyenne à l'hectare et une densité minimum de 7 % ; ce résultat a été obtenu sur certaines parties de la propriété irriguées depuis deux années.

En ce qui concerne les céréales, les irrigations ont eu lieu avant les ensemencements sur un sol préparé après de légers colmatages.

Le rendement à l'hectare a été, pour les cultures de blé, de 36 hectolitres.

Pour éviter la verse qui aurait pu se produire sur un sol abondamment pourvu d'azote, on avait ajouté, comme engrais complémentaire, des phosphates de Pernes, en proportion variable, suivant la nature des terrains, le nombre et la durée des arrosages.

La production du seigle a été de 40 hectolitres en moyenne à l'hectare, sans engrais complémentaires. La récolte de l'avoine, sur des terrains faiblement irriguées, a été 48 hectolitres.

La récolte en fourrages, ainisi qu'on l'a constaté dans toutes les fermes cultivées à l'eau d'égout, a été très abondante.

Les luzernes, qui conviennent bien aux terrains crayeux de Champagne, ont donné une moyenne de 20,000 kgs. de foin sec par hectare, en 3 coupes, correspondant à 80,000 kgs. d'herbe verte à l'hectare. Cette culture exige une irrigation modérée, nécessitant quelques précautions dans les arrosages.

Le ray-grass d'Italie a donné également de bons résultats. La récolte a atteint une moyenne de 90,000 kgs. d'herbe verte à l'hectare. Ce fourrage a été consommé en vert, la dessication de l'herbe étant devenue difficile par suite de l'abondance de la récolte. Malgré ces résultats nous pensons que la culture de la luzerne comme fourrage artificiel est préférable au ray-grass d'Italie dont les tiges deviennent trop fortes, ce qui nuit à la qualité du fourrage.

Quant aux prairies naturelles, le rendement a été, en deux coupes, de 10,000 kgs. de foin sec à l'hectare. Ces prairies un peu acides sont en voie d'amélioration. Elles seront, d'ailleurs, mises en culture et recevront, ainsi que nous l'avons dit précédemment, des engrais complémentaires sous forme de scories de déphosphoration.

Tels sont les résultats obtenus pour une première année d'exploitation normale.

Lorsque toutes nos améliorations foncières seront terminées et que les irrigations auront pu être faites régulièrement sur tout l'étendue de la propriété, nous pensons augmenter dans de notables proportions notre production agricole.

Pour éviter les inconvénients qui peuvent résulter d'un retard dans l'enlèvement des récoltes, on termine actuellement l'installation d'une distillerie qui permettra de transformer, sur place, les produits agricoles, notamment les betteraves et les pommes de terre. Les pulpes de la distillerie seront utilisées, concurrement avec les fourrages récoltés sur les propriétés, pour nourrir des bestiaux à l'engrais dans les trois fermes de la Compagnie.

L'assolement de l'exercice 1891 comprend 280 hectares de betteraves à sucre, qui produiront approximativement 15,000,000 de kgs. Ce chiffre indique suffisamment l'importance de cette installation.

Il résultera de cette organisation une économie appréciable dans les transports, une plus grande rapidité dans l'enlèvement des récoltes, et enfin une meilleure utilisation des produits de l'exploitation.

La Compagnie des Eaux Vannes, après avoir organisé l'exploitation et fixé les meilleures méthodes culturales, a loué à une Société agricole spéciale tous les terrains irrigués, moyennant un prix annuel par hectare établi comme suit :

100 et 150 fr. pour les 2 premières années ;
200 fr. pour les 8 années suivantes ;
225 fr. pendant 10 autres années ;
et 250 fr. pour les 16 années restant à courir jusqu'à la fin de la concession.

Ce prix de location, sans être excessif, paraît cependent suffisant pour assurer aux capitaux engagés dans cette opération une rémunération appréciable.

Pour permettre de fixer exactement les idées sur les résultats que l'on doit attendre de l'épuration par le sol, il faut éviter de faire supporter par l'exploitation agricole des dépenses qui ne la concernent qu'indirectement, c'est-à-dire qu'il convient de séparer nettement, dans tout projet, les dépenses d'adduction ou d'élévation des eaux—qui doivent être considérées conme dépenses d'assainissement proprement dites,—des dépenses de distribution d'eau ou d'aménagement du sol qui sont spécialement afférentes aux irrigations.

On a fait remarquer très souvent que les exploitations agricoles utilisant les eaux vannes n'avaient pas donné de résultats satisfaisants au point de vue financier; mais en cherchant les causes que ont pu occasionner les insuffisances signalées, il est facile de reconnaître que, dans la plupart des cas, on a fait supporter à l'agriculture des charges qui incombaient aux villes.

Pour éviter une semblable interprétation, il conviendrait d'admettre comme principe que l'évacuation des eaux d'égout et leur épuration constituent une obligation pour les villes.

Les canaux d'adduction ne sont, en réalité, que le prolongement du réseau d'égouts. Si la configuration topographique des lieux ne permet pas l'irrigation par gravitation du champ d'épuration, il y a lieu de laisser également les dépenses d'élévation des eaux à la charge des villes.

Les produits d'une exploitation agricole ne permettent de supporter que des dépenses réellement afférentes à cette exploitation. Il faut, d'ailleurs, tenir compte des frais d'epandage des eaux sur les terrains irrigués. A Reims, pour une superficie irrigable de 520 hectares, le personnel occupé à la répartition des eaux se compose, suivant les saisons, de 12 à 14 ouvriers avec 2 chefs d'équipe. Ces frais augmentent nécessairement le prix de revient de l'engrais répandu sur le sol, et si l'on ajoute encore d'autres frais, tels que les intérêts et l'amortissement des dépenses de premier établissement, on rendra l'exploitation plus onéreuse que dans une culture ordinaire—où l'on est obligé de faire l'acquisition d'engrais chimiques—et l'exercice se soldera toujours en perte.

En résumé, les dépenses concernant l'établissement des conduites d'adduction, l'élévation des eaux s'il y a lieu, doivent être supportés par les villes. Celles-ci ne doivent pas rechercher, d'ailleurs, des advantages ou considérer comme une source de revenus éventuels l'utilisation des eaux; elles doivent avoir pour but de faciliter l'épuration, tout en cherchant, naturellement, à rendre cette opération aussi peu onéreuse que possible pour elles.

Comme conséquence, il y aurait lieu d'accorder aux villes qui désirent appliquer l'épuration agricole les plus grandes facilités pour l'acquisition des terrains, en les autorisant à exproprier le minimum de surface nécessaire à l'épuration, tout au moins au point de vue de la salubrité.

Nous trouvons en Angleterre des examples où le prix exagéré des terrains et le refus d'expropriation ont été un obstacle à la réalisation économique de l'épuration agricole des eaux vannes. Il convient de se

préoccuper d'assurer aux communes les moyens de faire usage de ce mode d'épuration dont on reconnait les avantages incontestables, et c'est dans cette pensée que nous croyons devoir demander la sanction du Congrès d'hygiène, pour que les communes ou les départements puissent être autorisés à exproprier le minimum de surface nécessaire à l'épuration des eaux par l'arrosage des terres.

L'on doit, en effet, en matière d'expropriation, ne demander que le minimum de terrains nécessaires pour assurer l'épuration des eaux, sans se préoccuper de l'utilisation.

La surface de terrains qui a été reconnue nécessaire en France pour l'épuration des eaux d'égout de Reims, a été basée sur une irrigation d'un volume annuel de 40,000 mètres cubes par hectare. La dose de 40,000 m³ a été également déterminée par la loi d'assainissement de la Seine pour les irrigations dans la presqu'ile d'Achères.

Pour les grandes agglomérations urbaines, telles que la ville de Paris, la faculté d'expropriation pour les terrains spécialement affectés à l'épuration des eaux, assurerait le développement des travaux d'assainissement et faciliterait l'épuration agricole des eaux qui est appelée, croyons-nous à recevoir de nouvelles applications en France, où le sol et le climat permettent d'obtenir, au point de vue cultural, des produits rémunérateurs.

La ville de Paris donnant le bon exemple, poursuit son assainissement extérieur en affectant aux irrigations les terrains domaniaux d'Achères. Les projets d'extension actuellement à l'étude nous font espérer que l'épuration de la totalité des eaux d'égout de Paris sera prochainement réalisée.

L'Administration départementale de la Seine se préoccupe également de l'assainissement du fleuve en amont et en aval de Paris, et il y a lieu de prévoir que le Seine dont la pollution va toujours en s'aggravant et s'étend même jusqu'à Mantes, ne recevra plus, dans un avenir peu éloigné, aucune des impuretés qui la souillent dans la traversée des départements de la Seine et de Seine-et-Oise.

D'autres applications sont à l'étude dans différentes villes, mais le plus grand obstacle à l'exécution de ces projets est la question des voies et moyens dont la solution présente généralement de grandes difficultés.

Cette question financière vient de recevoir une heureuse solution pour la ville de Marseille. Cette solution, qui consiste à rendre obligatoire le raccordement avec les égouts, autrement dit LE TOUT A L'ÉGOUT, moyennant le paiement d'une taxe proportionnelle de vidange, permet, par la création de ressources nouvelles, de réaliser l'assainissement de la ville de Marseille, des faubourgs, des ports et des villages suburbains.

Si l'on peut regretter que la situation topographique de la ville de Marseille ne permette pas l'épuration des eaux par le sol, l'on doit se féliciter cependant de l'adoption du principe de l'obligation du "tout à l'égout."

Cette solution nouvelle, que recevra prochainement le sanction de l'autorité supérieure, créera un précédent qu'il sera permis d'invoquer en faveur des autres villes de France pour améliorer leur hygiène en leur permettant de réaliser leur assainissement interieur par la création d'un

réseau complet d'égouts, et leur assainissement extérieur par l'épuration agricole des eaux vannes.

On the application of an Intercepting Reservoir, of the Type of Mouras's Fosse, and of a Peat Filter for Sewage to the Separate system of Sewerage.

BY

L. Pagliani, Professor of Hygiene and Director of Public Health, Rome.

I.

In Italy, as in any other country where due importance is given to the improvement of local sanitary conditions, the question of town sewerage is eagerly discussed; but, in Italy, more perhaps than anywhere else, with its great general need of this kind of sanitary reform, do economical considerations influence the question.

Putting aside the hygienic reasons which do not permit the adoption of the French "*tout à l'égout*" system, in most of our towns the necessity of limiting expense compels us to choose a good separate system of sewerage. This system, however, to prove economical as well as hygienic in an agricultural country such as ours, must comply with the following important conditions:—

1st. It must permit the use of very small pipes for carrying the sewage from houses, and it must be free from the danger of obstruction or hindrance to the regular flow of the sewage.

2nd. It must allow the useful elements of that sewage to be available for agricultural purposes.

The use of small-sized pipes is important, not only because of the relatively lower cost of the pipes and of their setting, while permitting the use of more resistant and less permeable material, but because in such pipes it is easier to ensure a constant and thorough flushing. But, to adopt them without fear of inconvenience in their working, the sewage must be sufficiently fluid, and, above all, must never contain solid matters capable of, sooner or later, obstructing them.

The good derived from using the valuable constituents of sewage for agricultural purposes is, on the other hand, remarkable for the economy obtained with substances which otherwise would be lost, and for the assurance that filth is prevented from polluting waters or soil, and from thus disseminating disease.

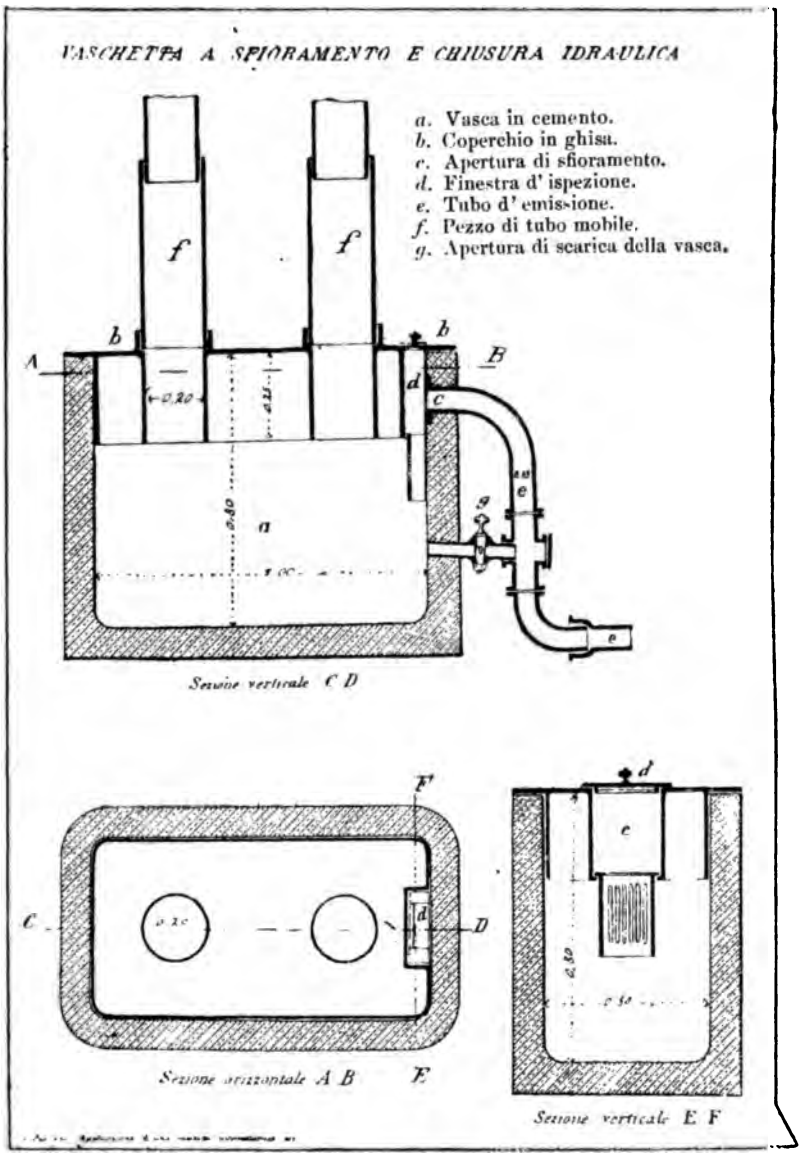
Knowing the difficulties met with by municipalities in the choice and successful application of such a separate system of sewerage, I have studied this problem experimentally, with the assistance of competent men working in the scientific laboratories of the Ministry of the Interior. The first question was the selection of a simple apparatus for securing a sufficient dilution of the soluble or emulsionable contents of privies, so that they might be separated from the irreducible and too voluminous portion, in order to enable me to send into small-sized pipes such a *liquid* as should never obstruct them, whilst the apparatus would allow

the removal of all foreign bodies which might have been occasionally introduced into the privy pipes. Secondly, it was necessary to set to work a filter capable of retaining the materials useful for agricultural purposes, but incapable of causing any danger to those localities in which the filtration is carried on—places, for instance, unprovided with land suitable for sewage irrigation.

II.

To solve the first point, I had proposed, in the year 1884, in a project of sanitary reforms for Turin, studied together with

PLATE I.



Signor Augusto Restelli, the application of a miniature Mouras's reservoir, which, after repeated experiments, I found it desirable to modify, as shown in the drawing represented in the Plate I. (figures 1, 2, and 3). The apparatus consists of a small reservoir made of cast iron or cement, whose dimensions are 1 metre in length, 0·50 in breadth, 0·80 in height. To close it, I use a cover made of cast iron (*b*, *b*), provided with flanges, which, with the liquid that very nearly fills the reservoir when at work, make a water-seal all round the edges as well as at the exit of the privy pipes.

As in every Mouras's reservoir, mine has an overflow opening (*c*) formed in this special type by a small watertight receptacle, provided with a grating through which bodies that may be floating in the liquid collected in the reservoir cannot pass. This opening has a diameter of only 5 c.m., equal to that of the tube which, starting from it, is continued by other pipes of increasing calibre, so that anything which passes through one length of pipe will certainly be able to pass onward through the next. At a point opposite to this opening is an inspection-hole, to permit the removal of bodies which might, by chance, hinder the regular flow of the liquid.

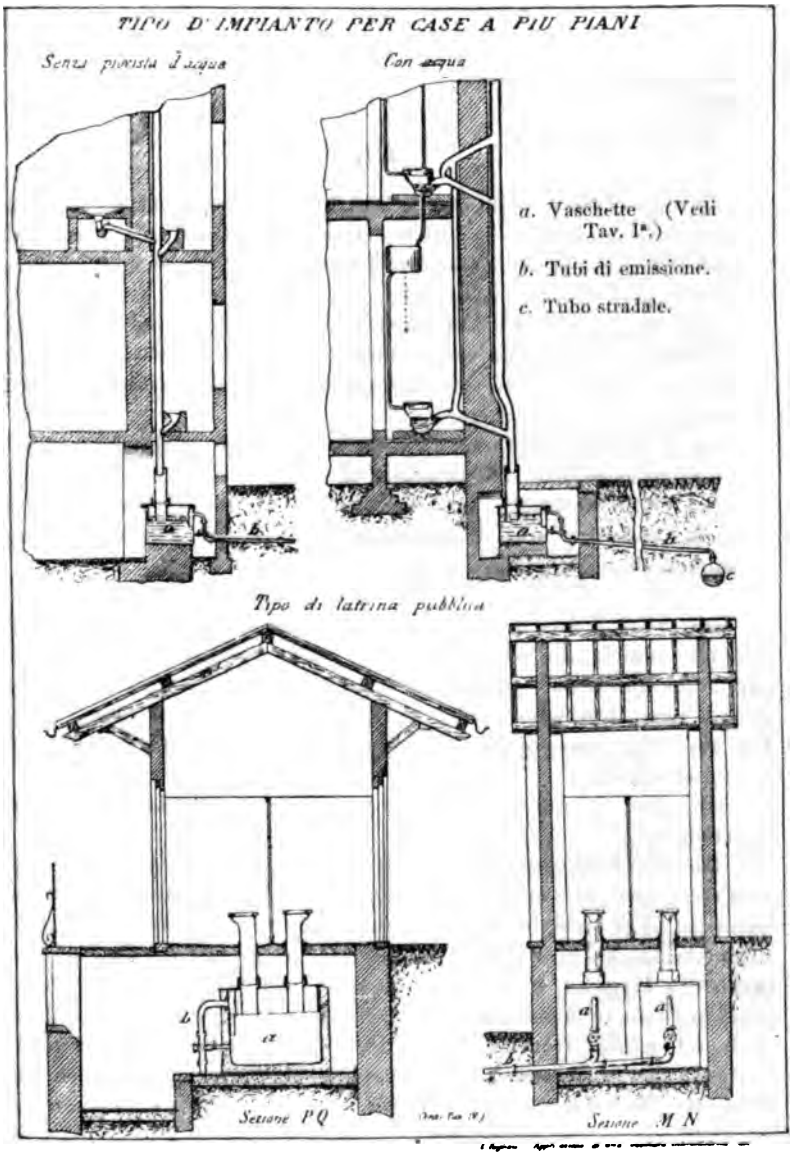
Experience has proved that such a reservoir works satisfactorily, without any inconvenience, for a very long period, so long as it is supplied with an abundant flow of water; but, should the water-supply be scanty, the floating layer may so thicken in the course of a few months as to hinder the further flow of sewage. In such a case, however, in order to set the apparatus to work again it is only necessary to draw off from the reservoir some liquid at one-quarter its height from the bottom by means of a pipe provided with a turncock (*g*); the surface of the liquid with its floating solid layer is thus lowered, and, by again filling the reservoir with water through the privy pipes, a great dilution of the sewage and its easy flow is obtained. This operation, even in the worst cases, need not be repeated more than once every three or four months, and is easily carried out. Nor does much trouble attend the emptying and cleansing of these reservoirs, which is only required at much longer intervals. It will suffice to nearly empty them of the whole liquid by letting it flow out through the lower opening, to lift the sliding cuffs of the privy pipes, and to raise the cover. The shape of this cover, while it fits with a closeness more than sufficient to prevent the exit of decomposition-gases from the reservoir, avoids the use of nails or screws, which would always involve trouble and labour whenever the cover had to be to be taken off.

On the other hand, the possibility that in case of the apparatus working irregularly, liquid may ooze from the reservoir through the chinks all round the cover, furnishes a means of easily and at once recognising the occurrence of such an inconvenience; whilst such an event, which is very rare, cannot cause any inconvenience in the use of the privies. This little apparatus must, of course, be placed in some spot easily accessible and floored with impermeable material. The cover may be modified, in case there be only one pipe from privy to reservoir, by making it in two pieces with flanges for immersion in the liquid, and so arranged as to render possible, by a single movement, the removal of the loose portion.

When thought more convenient for the position of the reservoir, the emptying pipe may be arranged independently of the upper tube, in order to draw off the liquid from the reservoir for agricultural purpose. In such a case the out-flow tube *e* may be disposed horizontally without any bend.

The liquid that comes from this reservoir is at all times such as easily flows out without depositing anything on the interior of the pipes. It would be easy, however, to adapt a flushing apparatus to

PLATE II.



them, as is practically used in every good system of separate sewerage (Plate II., figure 2). Two flushings per day, of 10–15 litres water each time, are enough to assure a perfect cleansing.

In Plate II., I have represented three methods of applying such reservoirs: 1st, when we have to deal with a many-storied edifice unprovided with water-pipes (figure 1); 2nd, when the same is provided with washing-water (figure 2); 3rd, when there are four privy-basins situated on the ground floor, as is the case with a public or school closet, &c., &c. As is indicated in the drawing, the reservoir might be used for only one privy pipe or for two; and it is also possible to couple two or more reservoirs to collect and dilute the sewage from several privies. The number of people which each reservoir may serve varies, to a certain extent, according to the quantity of water available for the dilution of the sewage.

III.

As regards the second object which I had proposed to myself, viz., to separate from materials so diluted those parts useful for agricultural purposes when the liquid cannot be carried directly to the fields, I have resorted to peat with the best results.

Since the year 1889, I had asked the head chemist of our laboratory, Prof. Monari, to undertake experiments as to the action of fine peat (which is abundant in Italy) on the organic matter and gases contained in sewage. The result was:—

1st. That peat containing 15°/₀ water is capable in a moist medium of absorbing more than half its weight of water.

2nd. That it absorbs organic compounds from animal evacuations and urine, including urea, decomposing them without meanwhile losing its original absorbing power.

3rd. That it checks the decomposition of organic matter.

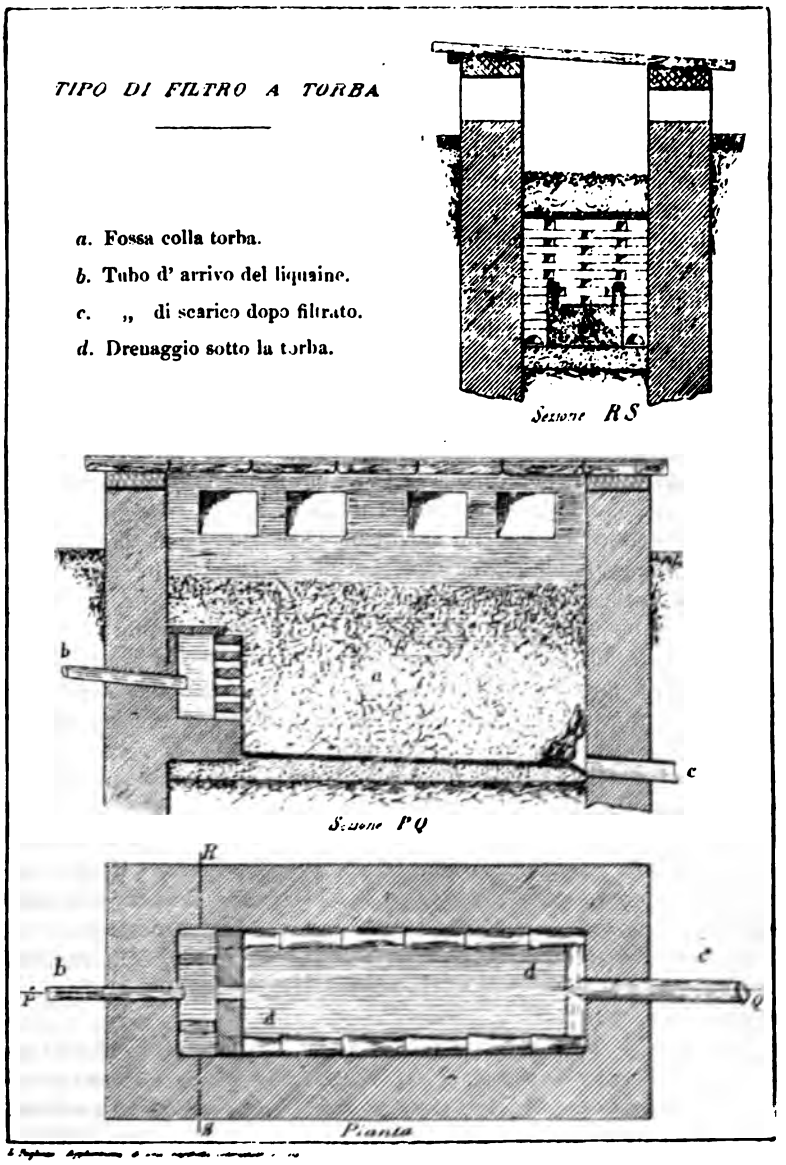
4th. That it has a very great absorbing power for those gases especially which are set free during such decomposition, and for sulphurous anhydride; though in a far less degree, or not at all, for several gases (carbonic oxide, carbonic anhydride, hydrogen, &c.). This absorbing power of peat for gases is far superior to that possessed by coal or water.

5th. That it rapidly decomposes hydrogen sulphide, ultimately absorbing it.

The absorbing power and deodorant properties of peat have long been recognised, to some extent at least; but I made experiments on a somewhat large scale, in our own premises, in the scientific laboratories under the Direction of Public Health and in the School for Student Doctors in Hygiene, with a population of about 150; and in an educational institute of about 300 girls at Massa. To this end I caused all the liquid strained from the above-described reservoirs attached to all privies in the buildings to filter through a thick layer of peat; sending thence the filtered liquid to the public sewers in the first case, and to a metallic tube in the second case.

The filter apparatus for sewage is represented in the third Plate. It consists of a pit walled with bricks and well cemented (figure 1), and roofed in such a way as not to allow rain-water to enter, while permitting a free circulation of air (figure 2). The pit has the dimensions of 2 metres in length, 1·40 in height, 0·80 in width, and is divided into two compartments, in the larger of which the peat is laid

PLATE III.



for an height of 80 centimetres. The liquid entering by the tube *b* flows into the first compartment, and thence through a grated wall enters the second one to penetrate the peat. To ensure a rapid flow of the liquid I had to set in the floor of the second compartment a drain *d*, *d* (figure 3). Thus the liquid, after having passed through the peat, comes out from the opposite end of the pit by the tube *c*. The pit is so constructed as to allow from time to time the turning over of the peat contained in it; and to get the full effect, the peat must never be completely immersed, but must always be allowed free exposure to air. With this precaution a relatively small quantity of peat will suffice to retain a great quantity of organic matters by reason of its power to facilitate their rapid oxidation.

In one of these filtering apparatuses with peat established in a courtyard of our scientific laboratories, Professor A. Monari has repeated chemical researches, to which he will refer in his publication "On the Filtration of Putrescent Liquids by means of Peat." The results of this accurate study, which concur with previous ones already drawn from researches made on the action of peat in general on organic substances, are as follows:—1st, natural peat, when penetrated by animal liquid evacuations, lets pass only (and that only partly) the urea or other simple nitrogen compounds; 2nd, but when saturated, lets also pass other substances of more complex nature; 3rd, after having been saturated, if peat is occasionally turned over or allowed to dry, it regains its former filtering power; 4th, sewage which has filtered through active peat does not undergo any further decomposition; 5th, peat retains not only organic matters of a complex nature, but it has a remarkable power of decomposing and oxidising them at the same time.

If these deductions are important from the point of view of agriculture and local convenience, I believe them to be still more important in the direction of preventive hygiene, because we can from them reasonably affirm with Monari that as the filtered liquid does not show any tendency to further fermentation, and contains a great excess of nitrogen, it must have become a liquid unsuitable to the growth of known microbes in general, and especially of those causing putrid fermentations, which require in their nourishing materials a great excess of carbon. Such liquid has, doubtless, become less dangerous in the public drains than that derived directly from privies.

In the section of microscopy and bacteriology of the same laboratories there are proceeding researches directed particularly to the discovery of how pathogenic micro-organisms eventually existent in sewage behave in their way through the dilution reservoir and through peat. It is not to be concealed, however, that it is difficult to arrive at positive conclusions on such subjects in the present state of our knowledge and means of research.

As regards the quantity of peat required, it is difficult to give exact data. In the above-mentioned experiment now being undertaken at our scientific laboratories, less than 2 cubic metres of peat have been used throughout the last nine months; and we are far from having

exhausted its activity, for more than half is yet almost intact, and the remainder is not yet in such a saturated state as to preclude its use after having been left to dry in a free current of air.*

IV.

As an example of a somewhat complex application of this system comprising watertight reservoirs, peat filter, and pipe drain, I give Plate IV., compiled by Filippo Danesi, civil engineer, working at the Technical Office of Public Health. In the Institute to which this plan applies, are gathered daily about 300 girls of every age. It was formerly provided with old well-privies in very bad condition. The town of Massa, in which it is situated, has no system of sewerage; it therefore was not possible to send the sewage into street drains, and, not being removed for many months from the spot, the sewage would be likely to pollute the soil and produce a great nuisance. For this reason it was decided to place, in an adjacent street, a cast-iron tube with the diameter of 0·15 metres and long enough to carry the liquid to an irrigation canal, giving to the tube dimensions sufficient to collect, eventually, sewage liquid from other edifices situated in the same street.

To four of the old wells in B (Plate IV.) were connected as many water-sealed reservoirs, C, built in cement; and for the Infant Asylum there was built in B′ a kind of kiosk for four privies, whose sections are given in Plate II. (figures 3 and 4). For this kiosk two of the said reservoirs have been provided, with two openings each, with two corresponding pipes on the cover, the upper end of which pipes may serve also as seats.

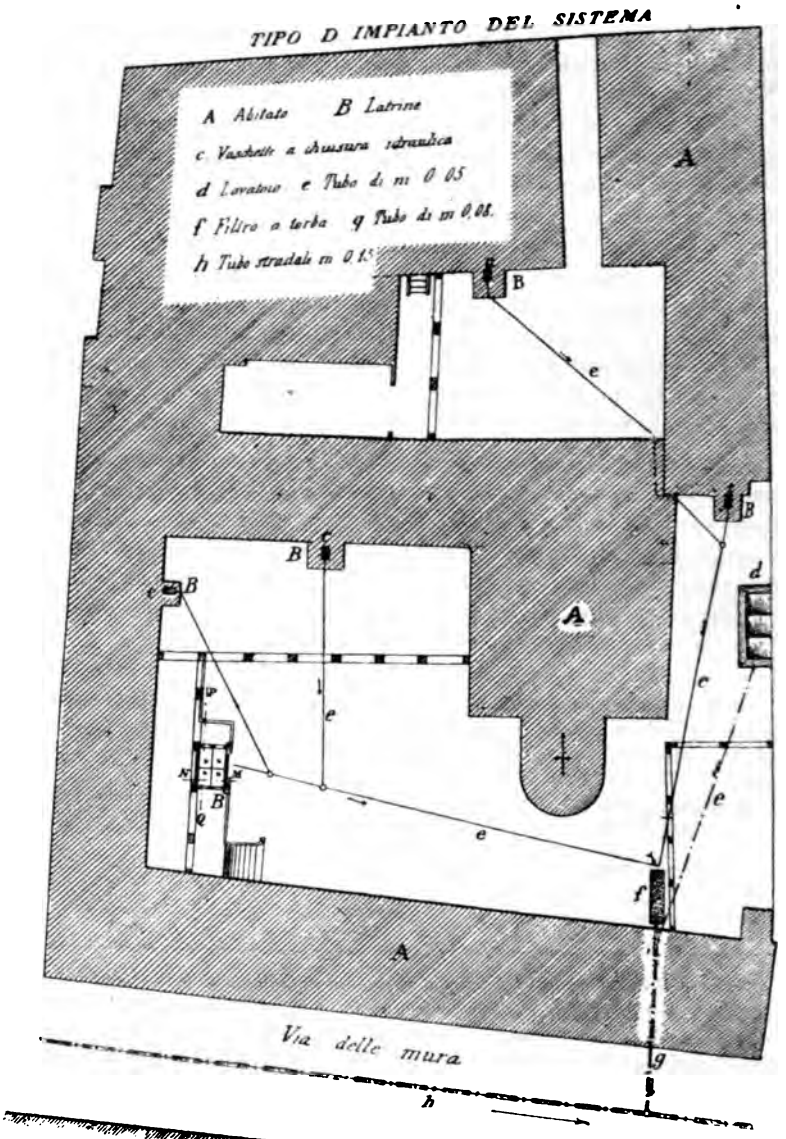
* We have examined the peat at different heights in the immediate vicinity of the grated wall which divides it from the privy liquid, and, the total peat layer being 80 centimetres high, we have found :—

Height of the Peat Layer examined.	Water and Substances Volatile at 100°.	Organic Substances (determined with Potassium Permanganate).
Centimetres.	%	%
50	61·86	12·13
30	64·68	12·04
10	68·24	22·96
0	70·28	13·71

The greatest quantity of the liquid passes through the peat at the height of 10 to 20 centimetres, and that is the reason why we find at 10 centimetres height the maximum of organic substances. At a higher level than 20 to 30 centimetres, the quantity of organic substances beyond that normally contained in peat is small, and this is the layer suited to absorb gases, especially the sulphurous gas, which are freed from the same liquid. It is natural that water be found in larger quantity the lower are the layers of peat we examine, because at the bottom is collected the filtered liquid; it is also natural that the same layers be somewhat richer in organic matters than the upper ones, but far less than those situated in the middle, at least till they are saturated. It is important to add that the liquid, before filtering through peat, contains, on an average, 25 per cent. of organic matters; after filtration it has only about 2 per cent., and this under the existing conditions, viz., when the peat has been in action for nine consecutive months.

The six reservoirs have been provided with tubes, *e*, with a diameter of 0·05 m., for conveying the liquid to a pit, *f*, of the above-described type, containing filtering peat. Between the pit and the street drain was inserted another pipe, with a diameter of 0·08 m., receiving at its

PLATE IV.



commencement the waste-pipe from a lavatory, whose waste-water is available for flushing the street tube. These tubes are laid with very little fall, only about 5 per cent.

In this case the installation was made under scarcely favourable conditions, because the water which the Institute may dispose of is small in quantity, and the closets serving the upper part of the building are of old construction, and without water-seal. In spite of all this, the whole thing works regularly, and, having been begun as an experiment, might be improved afterwards.

A similar experiment now being carried out in the premises of the Public Health Direction laboratories, under better conditions, works perfectly, the reservoirs having been placed in an entrance court, without giving rise to any trouble.

V.

As I have repeatedly, before now, declared, I am still of opinion that, in those localities where water is greatly deficient, and is not available for flushing the closets, even intermittently, movable reservoirs are to be recommended in preference to any other system, provided they be not made so as to separate the solid from the liquid matters, but to carry *all* the sewage away from the houses. I hold this idea because I believe it to be a very great mistake to send such matters into drains, when the watery vehicle is not present in sufficient quantity to carry them completely to a convenient distance from dwelling-houses.

In the great majority of cases, however, including the populous centres of some importance, where it is possible to use water for intermittent or continuous flushing of the closets (and, still more, where the waste-water of the town must be, in any case, carried far from the dwellings, whilst there are no running streams such as existed in ancient Rome to flush her enormous canals), I am still of opinion that the tubular system which separates sewage from storm-water is preferable. It is preferable for hygienic reasons, because it is only with these small-sized tubes that we can, with certainty, avoid infiltration into the soil of putrid liquids, and the exit of gases into the air. It is preferable for economical reasons, because it costs far less to provide and to maintain in working order, and because it is possible by this method to utilise the useful constituents of the sewage for agricultural purposes, without the encumbrance of that enormous quantity of water which is inevitable with the system of "*tout à l'égout*," an encumbrance which is greatest under the very seasonal conditions which make irrigation less necessary and more difficult to carry out.

With the desire to help in solving the difficulties which still attend the usual method of working the separate tubular system, I venture to recommend the apparatus described above, with the hope that it may be tried experimentally on a large scale with good results.

Les Procédés d'Assainissement des Villes.

PAR

M. le Docteur HENRI HENROT, Maire de Reims, Professeur d'Hygiène à l'École de Médecine, Correspondant de l'Académie de Médecine de Paris.

La question de l'assainissement des villes, depuis les beaux travaux d'Alfred Durand-Claye, a fait d'énormes progrès; tous les hygiènistes reconnaissent aujourd'hui qu'il n'y a qu'un seul moyen complètement efficace de débarrasser les villes de leurs eaux d'égouts et de leurs matières résiduaires.

L'épuration par le sol.—Il serait intéressant de faire connaître l'état général de l'épuration agricole par les eaux-vannes dans les différents pays d'Europe; nous ne voulons pas présenter aujourd'hui ce travail, nous nous contenterons de tirer de l'installation que nous avons faite à Reims, où depuis plusieurs années toutes les eaux sont épurées par le sol, quelques enseignements pratiques qui pourront être utiles aux villes qui cherchent à appliquer chez elles ce système; nous voudrions résumer le "Manuel de l'assainissement des villes à l'usage des maires."

Pour pratiquer l'épuration par le sol, une ville doit se préoccuper des conditions suivantes:—

L'étude de la nature du sol qui doit toujours être perméable.
Le choix des terrains d'épuration.
La distribution de la canalisation intérieure et des collecteurs.
L'établissement de canaux évacuateurs pour rendre à la rivière les eaux épurées.
L'établissement de réservoirs de chasse à la tête des principaux égouts.
L'établissement de cheminées d'appel avec brûloir pour assainir l'air des égouts.
L'établissement de vastes bassins de décharge pour emmagasiner les eaux abondantes d'orages ou de fonte de neige.

Nous allons examiner sommairement chacun de ces points.

Étude de la nature du sol.—C'est une condition indispensable pour rendre possible l'épuration par le sol de trouver un terrain perméable; il est évident qu'un terrain granitique ou composé exclusivement de terre glaise n'est pas apte à se laisser pénétrer par les eaux.

En dehors de ces conditions, tous les terrains, en subissant des modifications que nous étudierons au cours de cette communication, peuvent être utilisés.

Il ne suffit pas que l'eau pénètre, il faut également que l'air aille jusque dans les profondeurs du sol opérer l'oxydation ou la nitrification des matières organiques, de là, la nécessité absolue de pratiquer des irrigations intermittentes.

Quant à l'épaisseur de la couche filtrante, elle variera selon la nature des terrains ; les germes pathogènes étant retenus par les couches les plus superficielles du sol, si l'on veut assurer une épuration complète, il est bon de donner deux mètres d'épaisseur aux terrains à traverser par les eaux. Cette épaisseur est surtout nécessaire lorsque les terrains sont très-divisés, très-peu compactes ; quand ils sont compactes ou formés par un sable fin, cette épaisseur peut être réduite.

A Reims, où les terrains sont très-perméables, nous avons vu quelquefois, même avec une épaisseur filtrante de deux mètres, l'eau sortir sale ; nous en avons recherché la cause ; nous avons pu constater une fois qu'un trou de taupe établissait une communication directe entre la surface irriguée et le canal évacuateur ; il a suffi de boucher cet orifice pour faire cesser immédiatement cette situation anormale. Ces animaux, comme les vers, peuvent avoir une influence utile pour faire pénétrer l'air dans le sol, mais ils peuvent aussi, exceptionnellement, nous le reconnaissons, entraver la marche régulière de l'épuration.

Choix des terrains d'épuration.—Le choix de ces terrains a une importance capitale, car de là dépend tout le succès de l'opération Il faut, tout d'abord, pour les municipalités, ne pas chercher à réaliser sur ce point des économies ; ces terrains doivent être vastes, plus étendus que ne l'indiquent généralement les traités d'hygiène, car, si l'épuration par le sol permet de rendre un grand service à une ville en la débarrassant de ses eaux-vannes, l'opération deviendra pour elle beaucoup moins onéreuse, si l'on peut utiliser les matières azotées pour faire de l'utilisation agricole ; or celle-ci n'est possible que si, à certains moments, on peut complètement cesser l'épandage pour permettre la maturation complète des fruits ou des plantes.

A Reims, la ville et la société possèdent six cents hectares pour utiliser 36,000 mètres cubes d'eau par jour.

Il faut autant que possible que la zone d'irrigation puisse s'étendre, se développer, soit que la ville utilise ses terrains pour son propre compte, soit qu'elle vende de l'eau aux populations riveraines. On choisira de préférence des terrains où les eaux d'égout puissent arriver par simple gravitation au double point de vue du bon fonctionnement du service et du côté économique du projet ; il ne faut pas craindre d'éloigner les champs d'épuration en donnant plus de longueur aux collecteurs pour obtenir ce précieux résultat. A Reims, l'égout transversal supérieur porte 12,000 mètres d'eaux à six kilomètres de la ville, où elles arrivent par simple gravitation à cinq mètres au-dessus du sol, de façon à permettre des irrigations méthodiques sans le secours de machines élévatoires. Les 24,000 mètres cubes d'eau de l'égout transversal inférieur doivent au contraire être relevés par des machines à vapeur, à cause d'une mauvaise disposition de l'ancien réseau d'égout.

Il ne faut pas toutefois s'arrêter devant la dépense de la surélévation des eaux ; la condition principale est de s'assurer une quantité suffisante de terres où les cultures les plus productives pour la région puissent être employées. Près des villes, la culture maraichère, qui utilise une grande quantité d'eau, devra être choisie de préférence ; si

l'on n'a pas de débouché direct pour les légumes, la culture des betteraves donnera d'excellents résultats.

L'année dernière, à Reims, 250 hectares étaient plantés de betteraves; la qualité en sucre n'a rien laissé à désirer; il faut toutefois cesser l'irrigation pendant plusieurs semaines avant la récolte. Il est donc absolument indispensable de posséder des terrains supplémentaires pour épurer les eaux pendant cette période de la maturation des plantes ou des fruits.

Les céréales, qui réclament beaucoup moins d'eau, ne seront employées que lorsque l'on aura des terrains très-vastes et très-secs.

Les prairies artificielles rendront de grands services là où l'herbe pourra être consommée sur place à l'état vert. À Reims, la société fermière s'est arrêtée à la culture de la betterave; elle va établir comme annexe une distillerie; l'utilisation agricole peut donc avantageusement être complétée par une exploitation industrielle bien entendue.

On voit, par ces considérations combien il est important pour les villes, dont l'existence est indéfinie, de choisir tout d'abord les terrains les plus favorables pour l'épuration, puisque c'est le moyen de tirer parti de tous les produits et de diminuer la dépense annuelle d'un des services les plus indispensables pour placer une cité dans les meilleures conditions hygièniques.

La cessation des irrigations au moment de la maturité des fruits ou des plantes a un double avantage: elle donne beaucoup plus de qualité au produit et elle assure une innocuité complète, soit aux fruits soit aux légumes; si ceux-ci avaient été salis par l'eau, l'air et le soleil détruiraient bien vite tous les germes pathogènes.

Nous ne saurions donc trop recommander à nos collègues municipaux de ne pas craindre de faire les plus grands sacrifices pour s'assurer, dans la conception des projets, la plus grande étendue de terrains propres à l'irrigation. Ce qui a été fait à Reims peut servir de précédent, l'état nous ayant autorisés à recourir à l'expropriation publique pour nous assurer, non seulement le passage des collecteurs, mais aussi les terrains d'irrigation. Ce fait est important, car si l'expropriation pour la construction d'un canal ou d'un chemin de fer est limitée par la largeur de la voie, pour les terrains d'épuration, l'étendue ne pouvait être fixée d'une façon précise; la quantité à fixer étant un peu arbitraire, on pouvait se demander si l'etat consentirait à laisser, entre les mains des communes, une arme aussi terrible que l'expropriation publique. L'état a autorisé, il a bien fait; au nom de l'hygiène, nous ne pouvons que l'encourager à persister dans cette voie, l'intérêt général devant toujours passer avant les intérêts particuliers.

Distribution de la canalisation intérieure et des collecteurs.— L'organisation de la canalisation intérieure des villes et la direction des collecteurs, sont une conséquence forcée du choix des terrains d'épuration; deux principes s'imposent: donner aux égouts une pente suffisante pour aller du point de départ au point d'arrivée des eaux, et surtout ne pas gaspiller la pente à l'origine, en vue d'amener les eaux sur les champs d'épuration à une hauteur suffisante pour éviter, si cela est possible, l'emploi de machines élevatoires.

Ce qui s'est passé dans notre ville peut être utile à connaître pour les municipalités qui veulent installer un service d'épuration. Il y a vingt ans, tous les égouts étaient dirigés vers la rivière et s'y déversaient directement ; quand on a voulu supprimer cette pollution de la ville, qui était transformée en un veritable égout, il a fallu construire un collecteur le long de la rivière. Cet égout a deux inconvenients très serieux ; il a une pente insuffisante qui rend le cours des eaux trop lent, et les eaux qu'il charrie arrivant au champ d'épuration à un ou deux mêtres au-dessous du niveau du sol, elles ont besoin d'être relevées à l'aide de machines.

Un de nos regrettés confrères, M. le Dr. Brébant, a eu l'idée qui, lorsqu'il l'a émise, a été combattue par tous les ingénieurs, de couper la ville en diagonale par un vaste collecteur. Les eaux du haut de la ville, au lieu de se diriger selon la déclivité naturelle du sol, semblaient remonter pour couper perpendiculairement trois ou quatre petits vallons et arriver en dernière analyse à un vallon plus profond, où, par simple déclivité, elles se trouvent à cinq mètres au-dessus des terrains à irriguer.

Ce collecteur, qui mesure plus de huit kilomètres, a partout une pente suffisante ; grâce à ce travail, l'épuration de 12,000 mètres cubes va se faire à perpétuité dans des conditions faciles et économiques.

Il faut donc laisser de côté tous les anciens systémes et ne se préoccuper que de relier le point de départ ou point d'arrivée par la canalisation la plus directe, avec une pente régulière et suffisante. Une fois la direction du collecteur général arrêtée, les canalisations secondaires viendront s'y rattacher en utilisant, autant que possible, les égouts existants.

Établissement de canaux évacuateurs et suppression de chutes d'eau.—L'établissement de ces canaux joue une rôle excessivement importante dans le fonctionnement de l'irrigation ; il ne s'agit pas seulement d'installer des tuyaux de drainage pour rendre le sol plus facilement et plus rapidement perméable à l'eau et à l'air ; ces canaux évacuateurs permettent à l'ingénieur de changer la hauteur de la nappe souterraine, de transformer la nature du sol et de rendre ainsi irrigables des terrains qui primitivement ne l'étaient pas.

Nous avons cherché à faire ressortir combien il est important de ne pas perdre de pente dans la construction des égouts, afin irriguer la plus grande surface possible de terrains par simple gravitation, sans recourir à l'usage de machines élévatoires ; l'établissement, sur de longues distances, de vastes canaux d'assainissement, a permis à Reims de transformer des près-marais d'une valeur insignifiante, puisqu'ils ne produisaient qu'une herbe ne pouvant même pas servir de litière, en terres de rapport où toutes les cultures réussissent. Sur ces vastes surfacets, où le peu d'épaisseur de la couche filtrante rendait l'épandage des eaux impossible, la nappe a pu être ainsi abaissée de 1 mètre a 1 mètre 50.

Les beaux résultats que la Compagnie des Eaux-Vannes a obtenus par cette transformation lui ont valu du Ministère de l'Agriculture un encouragement de 100,000 francs.

Un autre moyen très-efficace a été mis en œuvre pour obtenir ce résultat : c'est le rachat de chutes d'eau sur la rivière, chutes qui étaient utilisées pour faire mouvoir des moulins.

Il faut donc retenir que par l'établissement de canaux évacuateurs prolongés à de longes distances, et par la suppression de chutes d'eau sur la rivière, l'ingénieur peut à volonté transformer des près-marais impropres à toute culture, impropres à l'irrigation, en terres irrigables et par conséquent productives.

Au double point de vue de l'économie de l'entreprise et de l'installation des champs d'épuration qui doivent être recherchés autant que possible sur les points bas pour éviter la sur élévation des eaux, ces transformations pourront rendre aux municipalités les plus précieux services, et, dans biens des cas, faciliter des travaux d'assainissement qui, sans cela, eussent été impossibles.

Établissement de réservoirs de chasse.—Pour assurer le nettoyage des égouts, il est important de placer, à la tête des collecteurs les plus considérables, des réservoirs de chasse ; cette opération eût été très-difficile à Reims, s'il nous avait fallu recourir, pour ces chasses, à l'eau de source nécessairement restreinte qui alimente la cité ; nous avons heureusement la possibilité d'emprunter au canal de navigation un volume d'eau considérable, qui nous permettra de faire, deux fois par semaine, des chasses puissantes. Cette installation reste à faire dans notre système d'assainissement.

Établissement de cheminées d'appel avec brûloir.—S'il est important de laver les égouts avec de puissantes chasses d'eau, il est bien nécessaire aussi, pour éviter les mauvaises odeurs qui se produisent en été et particulièrement par les temps d'orage, quand la pression atmosphérique baisse brusquement, d'assainir l'air des égouts ; cela est aussi indispensable pour permettre aux égoutiers de faire leur service sans danger.

Nous croyons donc qu'il y a lieu d'établir, dans les points hauts des égouts, des cheminées d'appel d'une aire suffisante et surtout assez élevées pour amener un puissant tirage avec des brûloirs à coke.

Nous avons à Reims une seule de ces cheminées, adossée à un établissement municipal ; le brûloir est constitué par un vaste foyer alimenté avec du coke ; ce combustible est beaucoup plus commode que la houille ou le bois, car il ne produit pas de fumée ; le feu s'entretient facilement et sans grande dépense. Nous songeons sur d'autres points à utiliser les hautes cheminées d'établissements industriels. Les mauvaises odeurs se produisant surtout le soir, alors que cesse l'écoulement des eaux industrielles, écoulement considérable dans notre ville, puisque, sur 36,000 mètres cubes entrés par jour, celles-ci en représentent à peu près 30,000 mètres ; il serait facile de se servir de ces cheminées pendant deux ou trois heures, une fois le travail des ateliers terminé. Nous étudions ces différentes installations.

La ville de Paris qui souvent, dans les quartiers hauts, est infectée, surtout le soir et la nuit, par des odeurs si désagréables, pourrait avec beaucoup d'avantage recourir à ce moyen simple et peu coûteux ; il a en

outre un autre avantage, celui de détruire des germes pathogènes avant leur sortie de l'égout.

Établissement de bassins de décharge.—Quels que soient le soin que l'on ait pris et l'importance que l'on ait donnée aux égouts, il est des cas où ils peuvent devenir insuffisants. Lors des pluies d'orages ou lors des fontes de neige, les eaux, arrivant subitement en grande abondance, peuvent détermiuer des pressions dangereuses sur les parois des égouts, ou elles peuvent être rejetées directement dans le fleuve ou dans la rivière sans avoir subi d'épuration.

C'est pour remédier à ces graves inconvénients que nous avons installé, en dehors de la ville et le long de chacun de nos collecteurs, de vastes bassins de deux à trois hectares, creusés simplement dans la terre et plantés de peupliers; en temps ordinaire, ils sont couverts d'herbes; lors des pluies d'orages, ils s'emplissent, recueillent toutes les eaux qui ne trouvent pas un écoulement facile dans les collecteurs et s'infiltrent dans le sol où, à la faveur des plantations, la transformation s'accomplit sans aucun danger d'infection pour la nappe souterraine.

Il nous a semblé utile de résumer brièvement les conditions essentielles à une bonne épuration des eaux d'égout par le sol; ce problème prend une importance beaucoup plus considérable depuis que le "*tout à l'égout*" s'impose, pour ainsi dire, à toutes nos villes modernes. La défectuosité de l'ancien réseau d'égouts de notre ville ne nous a pas encore permis de généraliser ce procédé si simple de l'assainissement des villes. Quand on peut créer de toute pièce un système d'assainissement, le problème est relativement facile; mais quand, dans les vieilles villes, on se trouve en présence de travaux faits depuis de longues années, sans plan d'ensemble, sans esprit de suite, le travail de réparation est souvent bien difficile.

Depuis vingt-cinq années, nous n'avons cessé d'étudier cette question comme hygiéniste et comme administrateur, nous serions heureux, si ces quelques conseils pratiques pouvaient être utiles à quelques-uns de nos collègues.

The Wolverhampton Sewerage Works.

BY

R. E. W. Berrington.

It is believed that the Wolverhampton Sewerage Works are the most complete of their kind in this country, and hence a short description of them may not be out of place.

Wolverhampton has a population of about 83,000, and the town forms an important centre of the South Staffordshire Iron Industry. It is essentially the home of the galvanized iron trade, and owing to this fact, coupled with its peculiar inland situation, the town occupies a unique and unparalleled position. It was one of the earliest of the large towns to take up the question of sewage disposal, and it attempted to efficiently deal with its sewage by means of broad irrigation, but this soon showed itself to be an impossibility. Whatever may be done by a

sufficient area of suitable soil with an ordinary domestic sewage, it was apparent that for a large manufacturing town like Wolverhampton the removal of certain solid and other constituents from the sewage was a *sine quâ non*.

From the first, Wolverhampton had two difficulties to contend with :—

1. The peculiar nature of the sewage which—after treatment by the manufacturers—contained a good deal of iron and other matters.
2. The smallness of the brook into which the effluent had to be poured: the natural flow of this brook being considerably less than the effluent itself.

Iron in small quantities is said to be beneficial to land, but the application of raw sewage containing variable quantities of iron was found to be destructive to all vegetable life. Besides this, the iron in solution always produced a suspicious-looking effluent.

The Corporation determined to grapple with their difficulties, and they have successfully done so by carrying out the following works :—

a. A complete system of rainwater drains with outlets into the natural brook-courses.

b. Precipitation works capable of being worked on the continuous or quiescent system.

c. Sludge-pressing plant.

d. Preparation of land for the final treatment of the effluent.

By the adoption of the "separate" system the following advantages were secured :—

1. Reduction by millions of gallons in the sewage to be dealt with at the outfall, saving—in chemicals and manipulation alone—a considerable sum.
2. A tolerably uniform flow rendering treatment easy and practicable.
3. Prevention of crude sewage being washed into the brook, and the dispensing with storm overflows.
4. Prevention of sewer gases being forced—by the water pouring into sewers in enormous quantities—through the traps into the houses.
5. Prevention of stoppages in main sewers from leaves, road detritus, &c.
6. The sewers proper are now large enough for many years to come, and will permit of a water-carriage system for the whole town.

The precipitation tanks cover an area of 5,000 square yards, and are connected with a large carrier contouring the farm. There is a large liming house, engine and boiler houses, sludge reservoir, and complete sludge-pressing plant.

In consequence of the very high-class effluent insisted upon, it is necessary to keep the works in operation the 24 hours through, and for this purpose there is an installation of the electric light.

Evidence has recently been given by experts before a committee of the House of Commons showing that Wolverhampton has difficulties in dealing with its sewage peculiar to no other town in England ; and that

the Corporation have successfully coped with those difficulties says something for their energy and determination in solving one of the greatest problems of the present day.

Die Kanalisation der Stadt Berlin.

VON

Stadtrath MARGGRAFF, Berlin.

Die Entwässerung Berlins erfolgt durch die Kanalisation, welche über das gesammte Stadtgebiet ausgedehnt und in 12 Abschnitte, Radial-Systeme genannt, eingetheilt ist, von denen sich zur Zeit 7 in vollständigem und 2 in theilweisem Betriebe befinden, während 2 weitere Radial-Systeme noch im Bau begriffen sind und ein zwölftes erst in Angriff genommen werden soll, wenn die Bebauung in den dasselbe umfassenden Stadttheilen weiter vorgeschritten sein wird.

Es beträgt unter Zugrundelegung der Ergebnisse aus der Volkszählung vom 1. December 1890 in den einzelnen Radial-Systemen :—

—	I.	II.	III.	IV.	V.	VI.
Der Flächeninhalt in Quadratmetern.	2,727,720	3,492,350	3,897,200	8,616,670	8,078,020	3,691,100
Die Zahl der Einwohner -	177,838	169,183	100,623	341,311	317,493	139,816

—	VII.	VIII.	IX.	X.	XI.	XII.
Der Flächeninhalt in Quadratmetern.	3,077,300	5,596,500	5,178,900	4,607,800	4,185,200	2,900,000
Die Zahl der Einwohner -	87,028	99,918	30,753	93,487	328	17,271

Für jedes der im Betriebe befindlichen Radial-Systeme ist eine Pumpstation vorhanden, nach welcher die Abwässer der im Bereiche des Systems belegenen Grundstücke vermittelst gemauerter Kanäle und Thonrohrleitungen, welche mit Gefäll im Strassenkörper verlegt sind, geleitet werden. Die gemauerten Kanäle sind theils in Eiprofil von 0·9 m. bis 2 m. Höhe und einer Weite von zwei Dritteln der Höhe, theils in 2 m. hohem Tunnelprofil bei einer Weite von 1·5 m. bis 3·1 m. hergestellt; die Thonrohrleitungen haben einen Durchmesser von 0·21 m. bis 0·63 m. Von den Pumpstationen aus, wo die Abwässer in einen Sammelbrunnen gelangen, werden dieselben mittels eines Saugrohrs in die Maschinen aufgenommen und von diesen nach den Rieselfeldern durch gusseiserne, 0·75 m. und 1 m. weite Röhren gedrückt.

Die Länge der am 1. April 1890 in den einzelnen Radial-Systemen vorhanden gewesenen Kanäle, Thonröhren und Druckrohre ergiebt sich aus folgender Zusammenstellung, wobei zu bemerken ist, dass die

Radial-Systeme VIII. und X. erst zum Theil funktioniren, IX. und XII. noch im Bau begriffen sind und XI. überhaupt noch nicht in Aussicht genommen ist.

Es waren vorhanden in den Radial-Systemen :—

Länge in Metern.	I	II.	III.	IV.	V.	VI.
Gemauerte Kanäle - -	9,958	14,223	10,026	24,220	22,097	9.941
Thonröhren - - -	36,785	54,753	81,091	103,417	80,532	41,185
Eiserne Druckrohre - -	15,142	12,506	21,534	14,301	7,988	1,218

Länge in Metern.	VII.	VIII.	IX.	X.	XII.
Gemauerte Kanäle - -	11,568	9,733	4,903	5,212	3,877
Thonröhren - - -	26,588	16,852	6,957	10,213	3,119
Eiserne Druckrohre - -	20,302	14,069	—	9,110	—

Bei den in vollständigem Betriebe befindlichen Radial-Systemen I. bis VII. betrugen die Kosten, in Mark ausgedrückt, für :—

——	I.	II.	III.	IV.	V.	VI.	VII.
Kanäle und Thonrohrleitungen.	2 241,267	3,212,939	3,655,036	5,496,471	4,291,576	1,697,785	2,087,689
Druckrohr - -	1,973,740 gemeinschaftlich		1,094,587	1,788,257	957,943	2,297,250 gemeinschaftlich	

und speciell für Material und Verlegung der eisernen Druckrohre, pro laufendes Meter berechnet, bei 0·75 m. weitem Rohr im Radial-System I. = 102 M., im Radial-System III. = 87 M., in den Radial-Systemen VI. und VII. = 96 M. ; bei 1 m. weitem Rohr aber im Radial-System I. = 129·5 M., im Radial-System IV. = 125 M., im Radial-System V. = 116 M. und in den Radial-Systemen VI. und VII. = 100 M.

Die Flächenausdehnung der im Betriebe befindlichen 9 Radial-Systeme betrug am 1. April 1891 rund 4,486 ha., der Flächeninhalt der in denselben belegenen Strassen rund 1,121 ha., die Längenausdehnung der letzteren 430 Kilometer. Die Strassenentwässerungsleitungen dieser 9 Radial-Systeme hatten eine Gesammtlänge von rund 586 km.

Am 1. April 1891 waren 20,307 Grundstücke an die Kanalisation angeschlossen, und zwar :

1,677	Grundstücke	im	Radial-System	I.
2,912	„	„	„	II.
3,093	„	„	„	III.
4,820	„	„	„	IV.
3,855	„	„	„	V.
1,544	„	„	„	VI.
1,693	„	„	„	VII.
220	„	„	„	VIII.
493	„	„	„	X.

und wurden aus denselben während des Jahres 1. April 1890–91 an Kloset-, Wirthschafts- und Regenwasser den Rieselfeldern durch Vermittelung der Pumpstationen insgesammt 52,483,102 Cubikmeter zugeführt, welche sich auf die einzelnen Radial-Systeme, wie folgt, vertheilen :—

Aus Radial-System.	Im Ganzen. cbm.	Durchschnittlich täglich. cbm.	Pro Kopf der Bevölkerung täglich. cbm.
I.	5,049,322	13,834	0·085
II.	8,839,134	24,217	0·141
III.	7,515,625	20,591	0·192
IV.	10,461,159	28,661	0·092
V.	10,265,787	28,125	0·091
VI.	5,332,011	14,608	0·130
VII.	3,396,234	9,305	0·097
VIII.	388,471	1,832	0·137
X.	1,235,449	3,688	0·179

wobei zu berücksichtigen ist, dass das Radial-System VIII. erst vom 1. September 1890, das Radial-System X. erst vom 1. Mai 1890 ab, und zwar jedes derselben auch nur zum Theil, in Betrieb gesetzt ist.

Die Rieselfelder selbst bestehen, soweit sie den im vollständigen Betriebe befindlichen Radial-Systemen dienstbar gemacht sind, aus 4 grösseren Gütercomplexen, welche ein Gesammt-Areal von 4,458 ha. umfassen, von denen 3,214 ha. aus Ackerland (Beeten, Wiesen, Bassins), Baumschulen, sowie Weiden- und Erlen-Anlagen bestehend, vollständig aptirt und drainirt sind, während die nicht aptirten, 1,244 ha. umfassenden Complexe in der Hauptsache aus Hofstellen, Gehölz, Fennen, Wasserstücken, Gräben, Wegen, Unland, aber auch aus Deputatland, Gärten, natürlichen Wiesen und Aeckern bestehen.

Die Rieselfelder sind durch Planirung, Aptirung und Drainirung zur Aufnahme der Abwässer aus der Kanalisation besonders hergerichtet worden. Die aus porösem Thon hergestellten Drainröhren liegen 1 bis 2 m. tief unter der Erdoberfläche und münden in Abzugsgräben, welchen sie die durch den Erdboden filtrirte und gereinigte Spüljauche als ziemlich klares Wasser zuführen, das auf seinem weiteren Wege in die öffentlichen Flussläufe gelangt, soweit es nicht verdunstet.

Die Drainwässer, d. h. die nach der Filtration durch das Erdreich vermittelst der thönernen Drainröhren in die Entwässerungsgräben geleitete Sewage, werden unausgesetzt einer regelmässig wiederkehrenden und eingehenden Untersuchung in Bezug auf ihre Beschaffenheit unterzogen. Die Resultate dieser Untersuchungen während des letzten Jahres sind aus den beifolgenden Tabellen ersichtlich :—

100,000 Theile enthalten	Osdorf und Grossbeeren.						Osdorf und		
	Drainwasser von Beetanlagen.						Spüljauchen.		
	Nr. 59. Beet 3 in Osdorf. 1.5.90.	Nr. 60. Beet 161 in Grossbeeren. 2.6.90.	Nr. 79. Beet 3 in Osdorf. 10.9.90.	Nr. 80. Beet 284 in Osdorf. 10.9.90.	Nr. 87. Beet 198 in Osdorf. 15.11.90.	Nr. 94. Beet 2 in Osdorf. 1.2.91.	Nr. 70. Grossbeeren. 15.7.90.	Nr. 93. Aus Schieber 15 in Osdorf. 1.12.90.	Nr. 95. Aus Schieber 11 in Grossbeeren. 1.12.90.
Trockenrückstand	126·24	110·24	115·68	111·44	220·40	88·48	93·44	164·88	133·68
Glühverlust desselben.	21·22	25·36	14·00	15·52	37·60	9·68	22·00	43·76	39·52
Glührückstand -	105·12	84·88	101·68	95·92	182·80	78·80	71·44	121·12	94·16
Uebermangans. Kali erford.	2·56	5·88	4·04	3·00	6·10	9·42	30·65	61·90	53·09
Ammoniak - -	1·28	1·28	0·96	0·32	0·03	1·28	8·81	23·61	17·39
	1·37	1·37	1·04	0·38	0·14	1·36			
Organ. gebund. Ammoniak.	0·09	0·09	0·08	0·06	0·11	0·08			
Salpetrige Säure -	2·22	1·62	0·98	0·70	0·87	0	0	0	0
Salpetersäure -	14·33	5·82	10·81	6·99	57·29	0	0	0	0
Schwefelsäure -	—	6·70	—	—	—	—	2·417	8·71	5·01
Phosphorsäure -	0·192	0·216	0·16	0·225	0·40	0·34	3·224	3·964	3·28
Chlor - -	28·16	22·88	30·83	24·57	44·18	24·03	24·52	50·67	37·02
Kali - -	—	4·43	—	—	—	—	4·46	9·94	6·24
Natron - -	—	23·70	—	—	—	—	21·27	43·65	28·25
Keime in 1 Cubikcentim.	198,000	12,800	58,080	68,400	146,080	696,000	—	—	—

Grossbeeren.				Osdorf und Grossbeeren.			
Grabenwasser.		Drainwasser von Bassins.		Drainwasser von Wiesen.			100,000 Theile enthalten
Nr. 67. Lilowgraben in Osdorf. 8.7.90.	Nr. 82. Hauptentwässerungsgraben in Grossberen. 15.9.90.	Nr. 61. Bassin XII. in Osdorf. 2.6.90.	Nr. 107. Bassin XII. in Osdorf. 2.2.91.	Nr. 65. Wiese 283 in Osdorf. 1.7.90.	Nr. 66. Wiese 164 in Grossbeeren. 1.7.90.	Nr. 53. Wiese 187 in Osdorf. 15.9.90.	
117·92	88·24	109·76	86·28	126·64	69·60	129·30	Trockenrückstand.
16·72	9·76	27·68	12·08	10·40	10·32	9·12	Glühverlust desselben.
101·20	78·48	82·08	74·20	116·24	59·28	120·24	Glührückstand.
3·70	2·69	16·48	7·51	3·25	4·27	2·62	Uebermangans. Kali erford.
0·64 } 0·72 0·08	0·24 } 0·28 0·04	1·76 } 1·84 0·08	1·76 } 1·90 0·14	0·04 } 0·06 0·02	0·14 } 0·20 0·06	0·03 } 0·03 Spur	Ammoniak. Organ. gebund. Ammoniak.
0·67	0·34	0	0·74	0	0·48	0	Salpetrige Säure.
9·38	7·95	Spur	0·41	3·78	8·64	13·80	Salpetersäure.
10·41	—	—	7·80	0·256	0·304	0·13	Schwefelsäure.
0·275	0·208	0	0·23	31·25	17·84	33·09	Phosphorsäure.
27·73	18·02	29·74	26·15	—	—	—	Chlor.
2·87	—	—	3·86	—	—	—	Kali.
24·13	—	—	22·35	—	—	—	Natron.
17,600	22,400	23	120,000	16,800	—	3,880	Keime in 1 Cubikcentim.

100,000 Theile enthalten	Falkenberg und Bürknersfelde.						Falkenberg und Bürknersfelde.					
	Nr. 71.	Nr. 91.	Drainwasser von Beetanlagen.			Nr. 81.	Nr. 57.	Nr. 73.	Nr. 74.	Nr. 100.	Nr. 101.	Nr. 102.
	Spüljauche aus Schieber 33 in Falkenberg.	Spüljauche aus Schieber 41 in Falkenberg.	Nr. 77. Beetanlage 444 in Bürknersfelde.	Nr. 92. Beetanlage 121 in Falkenberg.	Nr. 109. Beetanlage 126 in Falkenberg.	Drainwasser von Wiese 12 in Falkenberg.	Graben bei Schlag 39 in Bürknersfelde.	Wasser aus dem nördlichen und südlichen Sielgraben.	Hohenschönhausener Grenzgraben bei Schlag 468.	Nördlicher und südlicher Sielgraben.	Wuhle oberhalb des Sielgrabens.	Wuhle an der Neuahrensfelder Chausseebrücke.
	15.7.90.	1.12.90.	29.7.90.	2.12.90.	16.2.91.	15.9.90.	15.4.90.	21.7.90.	21.7.20.	15.1.91.	15.1.91.	15.1.91.
Trockenrückstand	134·64	135·84	148·64	124·16	119·04	117·68	141·44	107·76	96·48	93·76	31·60	107·68
Glühverlust desselben.	60·24	55·84	17·44	13·76	12·72	10·80	14·16	12·48	11·76	10·80	4·48	11·52
Glührückstand	74·40	80·00	131·20	110·40	106·32	106·88	127·28	95·28	84·72	82·96	27·12	96·12
Uebermangans. Kerford.	45·50	60·67	2·78	2·40	2·37	3·03	2·81	5·85	5·88	4·35	1·15	2·97
Ammoniak	11·50	18·68	0·12	0·10	0·11	0·16	0·12	0·56	1·60	0·72	0·03	0·72
Organ. gebund. Ammoniak.			0·06 } 0·18	0·04 } 0·14	0·05 } 0·16	0·05 } 0·21	0·05 } 0·17	0·14 } 0·70	0·14 } 1·74	0·11 } 0·83	0·01 } 0·04	0·06 } 0·80
Salpetrige Säure	0	0	0·25	0	0·29	0	0·42	1·44	0·61	0·55	0	0·42
Salpetersäure	0	0	21·77	13·87	15·29	14·60	19·41	1·45	2·82	4·91	0	6·87
Schwefelsäure	3·876	3·616	Spur	0·40	0 13	0·11	0·08	Spur	Spur	0·208	Spur	0·18
Phosphorsäure	3·76	4·41	—	—	—	—	10·93	—	—	—	—	—
Chlor	18·69	32·71	21·75	24·12	22·70	24·70	23·00	22·76	22·03	19·90	20	23·97
Kali	6·71	9·47	—	—	—	—	2·89	—	—	—	—	—
Natron	22·35	30·23	—	—	—	—	21·75	—	—	—	—	—
Keime in 1 Cubikcentim.	—	—	2,200	14,080	16,200	1,800	1,040	51,000	52,800	114,200	7,120	4,860

100,000 Theile enthalten	Malchow, Blankenburg und Wartenberg.						Malchow, Blankenburg und Wartenberg.			
	Spüljauche.		Drainwasser von Beetanlagen.				Wasser aus dem Fliessgraben.			Nr. 85.
	Nr. 72. Aus Schieber Nr. 1 in Malchow. 15.7.90.	Nr. 89. Aus Schieber Nr. 1 in Malchow. 1.12.90.	Nr. 58. Beetanlage 108 in Wartenberg. 15.4.90.	Nr. 63. Beetanlage 162 in Blankenburg. 16.6.90.	Nr. 90. Beetanlage 88 in Malchow. 2.12.90.	Nr. 112. Beetanlage 22 in Malchow. 17.3.91.	Nr. 64. Bei Anlagen 141–143. 16.6.90.	Nr. 98. Oberhalb Blankenburg. 15.12.90.	Nr. 99. Vor der Mündung in die Panke. 15.12.90.	Drainwasser von Wiese 25 in Malchow. 17.9.20.
Trockenrückstand	132·40	91·44	105·12	128·40	120·90	93·36	98·81	53·52	69·12	95·68
Glühverlust desselben	30·96	26·40	12·80	18·72	11·20	11·52	13·44	5·84	10·48	8·88
Glührückstand	101·44	65·04	92·32	109·68	109·76	81·84	85·36	47·68	58·64	86·80
Uebermangans. Kali erford.	43·29	39·85	2·12	4·53	2·50	2·69	5·34	2·59	3·07	3·16
Ammoniak Organ. gebund. Ammoniak	9·53	12·48	0·16 0·06 } 0·22	1·44 0·16 } 1·60	0·03 0·03 } 0·06	0·06 0·03 } 0·09	0·12 0·06 } 0·18	0·32 0·05 } 0·37	0·32 0·04 } 0·36	0·48 0·07 } 0·55
Salpetrige Säure	0	0	0·38	0·99	0	Minimale Spur.	0·57	0·29	0·36	0·44
Salpetersäure	0	0	8·58	6·25	9·57	17·13	4·59	2·10	2·84	4·34
Phosphorsäure	2·12	3·775	0·128	Spur	Spur	0·24	0·176	0·13	0·16	0·15
Schwefelsäure	18·56	4·404	8·27	—	—	—	—	—	—	11·43
Chlor	24·40	21·06	19·05	23·84	24·14	16·75	19·66	7·71	11·17	27·07
Kali	6·08	6·12	1·34	—	—	—	—	—	—	2·32
Natron	23·06	20·69	15·66	—	—	—	—	—	—	23·70
Keime in 1 Cubikcentim.	—	—	1,040	870	2,850	34,200	2,450	36,400	16,820	702

Die in früheren Jahren verbreitete, irrthümliche Ansicht, dass die Drainwässer auf die öffentlichen Flussläufe, welchen sie zugeführt werden, insofern einen nachtheiligen Einfluss auszuüben geeignet seien, als denselben eine Verminderung bezw. Erkrankung und ein Absterben der Fische zugeschrieben wurde, ist augenfälliger Weise dadurch widerlegt worden, dass auf einzelnen Rieselgütern Fischteiche angelegt wurden, deren Wasserversorgung lediglich durch Drainwasser erfolgte. In diesen Teichen wurden demnächst Bachforellen, Zander, Regenbogenforellen und Karpfen gezüchtet, welche ebenso wie deren Brut vorzüglich gediehen sind und sich in staunenswerther Weise vermehrt haben.

Aus unserem letzten, das Jahr 1. April 1889–90 umfassenden Verwaltungsberichte ist zu ersehen, dass auf den Aeckern der vorgedachten 4 Gütercomplexe gewonnen wurden:—an Oelfrüchten: Winterraps, Sommerraps, Winterrübsen, Senf, Kümmel; an Halmfrüchten: Winter- und Sommer-Weizen, Winter- und Sommer-Roggen, Gerste, Hafer; an Hackfrüchten: Runkelrüben, Möhren, Kohl, ferner Hanf; und dass von unseren Gutsverwaltungen 2,749 ha. selbst bewirthschaftet wurden, während 900 ha. verpachtet waren und 809 ha. theils als vorübergehend, theils als dauernd ertraglose Liegenschaften wie auch als Deputatland keine Einnahmen brachten.

Auch an eine grössere Anzahl von Privatbesitzern, deren Grundstücke den Rieselfeldern benachbart liegen, wird durch besondere Anschlussleitungen, welche jene Besitzer auf eigene Kosten den diesseitigen Kanalisationsleitungen haben anschliessen lassen, zur Berieselung ihrer Ländereien Sewage aus den diesseitigen Leitungen gegen Entgelt abgegeben. Die in dieser Beziehung an unsere Verwaltung gestellten Anträge auf Abgabe von Rieselwasser sind indess schon so zahlreich geworden, dass wir, um nicht eventuell selbst an Wassermangel auf unseren Rieselfeldern leiden zu müssen, denselben in weiterem Umfange, als bisher geschehen, nicht mehr zu entsprechen beabsichtigen.

Die Rieselwiesen, welche eine Gesammtfläche von 766 ha. ausmachen, liefern jährlich einen fünf- bis sechsfachen Schnitt. Das gewonnene Gras und Heu ist sehr begehrt und trotz der reichen Ernte nicht in ausreichender Menge vorhanden, um allen Nachfragen entsprechen zu können.

Ueberhaupt werden die Erzeugnisse unserer Rieselfelder mit Vorliebe gekauft; insbesondere decken die Bewohner der benachbarten Ortschaften ihren Bedarf an Viehfutter, wie Gras, Heu, Runkelrüben, Möhren u. s. w. fast ausschliesslich aus den Producten der Rieselgüter, da sie mit Rücksicht auf die Nähe der letzteren und deren reiche Erträge zum grossen Theil die Bestellung ihrer eigenen Ländereien mit Futterpflanzen eingestellt haben.

Ausser den erwähnten 4 Gütercomplexen besitzt die Stadtgemeinde Berlin noch mehrere zu Rieselzwecken bestimmte Güter, die aber erst zu einem kleinen Theil dem Rieselbetriebe dienen, zu einem weiteren Theile in der Aptirung und Drainirung begriffen sind und mit dem Rest nach den gemeinhin üblichen landwirthschaftlichen Grundsätzen bewirthschaftet werden. Dieser Grundbesitz umfasst ein Areal von rund

3,519 ha., so dass die gesammten, theils bereits als Rieselfelder eingerichteten, theils zu solchen bestimmten Ländereien eine Gesammtfläche von 7,978 ha. umfassen.

Die Wege und Alleen auf den Rieselfeldern sind mit Obstbäumen aller Art, welche in unserem Klima gedeihen, bepflanzt und ergeben reiche Ernte. Das gewonnene Obst ist sehr begehrt und liefert hohe Erträge. Die Zahl dieser Obstbäume beträgt rund 72,000. Ausserdem befinden sich noch in den auf den Rieselgütern angelegten Baumschulen etwa 150,000 Stück ein- und mehrjähriger Obstbäume. In den verschiedensten Gartenbau-Ausstellungen, welche mit den Erzeugnissen aus den Baumschulen und gärtnerischen Anlagen der Rieselgüter beschickt wurden, sind diesen Erzeugnissen erste und zweite Preise zuerkannt worden.

Von den 4 im vollständigen Rieselbetriebe befindlichen Gütercomplexen kosten einschliesslich der Ankaufspreise für den Grunderwerb, der Aptirung, Planirung und Drainirung:—

1. die Güter Osdorf, Friederikenhof und Heinersdorf rund 4,280,000 M., welche im Jahre 1890–91 einen Ueberschuss von rund 17,500 M. oder eine Verzinsung von 0·049 %;
2. die Güter Gross- und Kleinbeeren, Schenkendorf und Sputendorf rund 2,400,000 M., welche in demselben Jahre einen Ueberschuss von rund 61,500 M. oder eine Verzinsung von 2·56 %;
3. die Güter Falkenberg und Bürknersfelde mit den Hohen-Schönhausener und Marzahner Ländereien rund 3,700,000 M., welche in demselben Jahre einen Ueberschuss von rund 121,800 M. oder eine Verzinsung von 3·29 %;
4. die Güter Malchow, Wartenberg und Blankenburg rund 5,805,000 M., welche in demselben Jahre einen Ueberschuss von rund 134,800 M. oder eine Verzinsung von 2·32 % erzielt haben.

Der Gesundheitszustand der Bevölkerung auf den Rieselgütern ist ein durchaus befriedigender. Die Zahl der Erkrankungen ist verhältnissmässig keine grössere als in den Städten oder auf dem Lande. Jeder einzelne Krankheitsfall wird mittels einer besonderen, von den auf den Rieselgütern angestellten Aerzten ausgestellten Zählkarte durch den bekannten Geheimen Medicinal-Rath, Professor Dr. Virchow, kontrollirt. Es ist nach diesen Untersuchungen festgestellt, dass die vorgekommenen Erkrankungen mit dem Rieselbetrieb in keinerlei Zusammenhang stehen und auch nicht durch denselben hervorgerufen sind. Seit einigen Jahren sind im Gegentheil auf den Rieselfeldern 2 Reconvalescenten-Stationen, die eine mit 60 Betten für männliche, die andere mit 70 Betten für weibliche, nach überstandener Krankheit der Erholung bedürftige Personen eingerichtet, welche sich des regsten Zuspruchs erfreuen und zu jeder Jahreszeit durchweg voll belegt sind. Des Ferneren ist eine Wöchnerinnen-Station für 60 Wöchnerinnen und deren neugeborene Kinder auf einem Rieselfelde im Bau begriffen und gleichfalls eine weitere Station für tuberkulöse Personen beiderlei Geschlechts.

Wednesday, 12th August 1891.

The Chair was occupied successively by
The President, Sir JOHN COODE, K.C.M.G.,
and
Mr. A. R. BINNIE, Memb. Inst. C.E.

Water Supply.

BY

ALEX. R. BINNIE, Memb. Inst. C.E., Engineer-in-Chief, London County Council.

In the forefront of our inquiries on the subject of a good water-supply it cannot be denied that, however obtained and however treated from an engineering point of view, we must, in the first instance, secure a water of good quality and unimpeachable purity.

At first sight this may appear almost a truism, but, unfortunately, we do not find it to be either universally admitted or always observed in practice. For this we have to look to the great and almost general result of our modern modes of life and civilization, which tends more and more to aggregate our population towards large centres of wealth and industry, and these, we observe, are generally situated on the banks of important rivers or in river valleys not far distant from tributary streams. Not only are thickly inhabited areas in themselves improper sources of water-supply, but they are, also, directly the cause of pollution to the streams and rivers which flow through them. Consequently we find many of the large towns of Great Britain which are governed by Municipal Corporations, such as Glasgow, Edinburgh, Lancaster, Manchester, Liverpool, Halifax, Bradford, Leeds, Belfast, Dublin, and many others, resorting at great expense to uncultivated and almost uninhabited mountain tracts, and bringing the water from great distances so as to obtain a pure and uncontaminated supply.

When, therefore, we occasionally see large towns and cities which have not considered it necessary to take these precautions or to incur the consequent expense, but still continue to drink the water of rivers largely polluted by the more or less clarified sewage and the manure of populous areas, we are led to ask ourselves the question whether the large expenditure of capital that has been incurred in certain cases to obtain a pure water-supply has not been an entire waste of our resources.

There can be little doubt that human beings can, for a considerable time, drink with impunity water largely contaminated with the excreta,

both solid and fluid, of healthy persons; and that they are able to do so with impunity, and without loathing and disgust, appears to be due to ignorance and apathy on the part of the water consumers, and to the power which rivers possess of apparently destroying and veiling the more gross and palpable polluting substances. There are some persons, no doubt, who teach that running water has the power of entirely destroying sewage and other polluting matter which may pass into it; but there are few, let us hope, who would say that we can, with safety, drink water which has been polluted with the excreta of persons suffering from cholera, typhoid, small-pox, and similar diseases; and yet this is practically the position taken up by those who advocate, unreservedly, the propriety of deriving supplies of drinking water from rivers on the banks of which, at no great distance, are situated large towns, for sooner or later we must expect epidemics to arise even under the most careful management.

Of two facts we may feel quite confident, first, that water subject to pollution is a very potent factor in the spread of disease; and second, that there is perhaps no better mode of introducing into the human system any substance which it can absorb than by drinking it in the form of a solution. This being the case it almost follows, as a natural consequence, that the utmost care should be taken to guard our supplies of drinking water from contamination; and yet we see persons around us who shut their eyes to observed and well known facts, and speak of the teaching of science and the experience of the world as sentiment, and who would continue to force upon a large number of their fellow creatures supplies of water contaminated with the excreta of millions of men and animals. That wells are frequent sources of death and disease, due to their contamination by house drains, is too patent to require a word of remark; and yet it required the cholera outbreak of 1849, and the death of some thousands of persons, to impress the fact on the people of London. And it appears to be forgotten that to drink river water polluted by sewage cost London in the cholera outbreaks of 1854 and 1866 the deaths of over 16,000 persons.

That people will go on for years drinking a supply contaminated by infiltration from graveyards, notwithstanding frequent warning, is proved by the outbreak of enteric fever in 1888, at Cradley, which caused 16 deaths in 113 cases.

The case of Lausen in Switzerland in 1872 proves that typhoid fever can be communicated by spring-water flowing miles underground from a neighbouring valley. The cholera outbreak in Spain in 1885 showed that, generally, the disease passed down the valleys, decimating the towns which drew their water from the rivers, but not affecting those which were independent of the rivers and had pure and uncontaminated supplies. In India the author has seen a town in which cholera had become endemic, almost entirely freed from that dire disease simply by giving up the water-supply derived from a populated drainage area and resorting to a purer and uncontaminated source. And the outbreak, last year, of enteric-fever in the districts of Stockton and Middlesborough and Darlington, which derive their water-supply from the River Tees,

proves that the germs of that disease are not destroyed by filtration or in their passage for over 13 miles down that river from Barnard Castle.

All these are cases in which chemical science is of little assistance, as it is powerless to detect the germs of disease; it can tell us of the presence of organic matter, but, without a careful inquiry into the previous life-history of the water, it cannot pronounce that, under all circumstances, it is a safe and pure drinking water.

Nor from the experience of Valencia in 1885, and of Stockton and Middlesborough, can we place much dependence on sand filtration as an effectual preventative of disease; sand filtration may arrest the living germs, but is unable, apparently, to stop the passage of the minute spores from which they spring. The precipitation and clarification of sewage effluent by chemical agency, also, can hardly be relied upon, as it merely abstracts about one-fifth of the more solid impurity, leaving four-fifths of the dissolved organic matter to flow off into the river.

What then are we to expect from the continuance of supplies to large cities from sources so polluted, but that such cities may go on for years, perhaps, boasting of the chemical purity of their water, and their low death-rate, forgetting that the constitutions of their water consumers are being gradually prepared, by continually drinking small quantities of diluted sewage, to receive the germs of some violent epidemic which sooner or later will visit the sources of supply; and then will follow such an outbreak of death and disease as will cause consternation throughout the land.

De la Distribution dans les Villes de deux eaux de qualite différente par des canalisations distinctes.

PAR

M. Bechmann, Ingénieur en Chef des Ponts et Chaussées chargé du Service de l'Assainissement de Paris, Professeur à l'Ecole Nationale des Ponts et Chaussées.

Depuis quelques années un certain nombre d'hygiénistes, frappés de la difficulté qu'on éprouve souvent à procurer aux habitants des villes l'eau pure et salubre en quantité suffisante, préconisent le *dédoublement des distributions d'eau*. Pour vaincre cette difficulté ou plutôt pour la tourner, ils recommandent l'établissement dans chaque agglomération urbaine de *deux canalisations entièrement distinctes*, de manière à porter en tous les points d'une part *l'eau potable* destinée aux usages qui la mettent en contact intime avec les parties les plus délicates de l'organisme humain, d'autre part l'eau affectée à tous les emplois où la salubrité n'est pas en cause ou ne l'est pas au même degré et qui peut être dès lors de *qualité inférieure*.

Le système est assurément ingénieux, et sans nul doute il fournit une solution rationnelle du problème. Aussi l'idée a-t-elle fait son chemin et trouvé des partisans dans tous les pays. Nous en avons la preuve dans le programme même de la viie Section du Congrès international d'Hygiène de cette année, puisqu'il porte au nombre des questions à l'ordre du jour la "*séparation de l'eau potable et de celle destinée à d'autres usages.*" Mais faut-il voir dans la double canalisation une solution générale, applicable à tous les cas? Constitue-t-elle le type unique des distributions d'eau conformes aux règles de l'hygiène? C'est ce que je me propose d'examiner.

Cette division, introduite systématiquement dans le service d'eau d'une ville, ce dédoublement complet de la distribution d'eau, n'est pas précisément chose nouvelle. L'illustre Belgrand, appelé en 1854 à diriger le Service des Eaux et Egouts de Paris, en a fait dès cette époque la base de ses projets pour l'alimentation normale de cette ville. Malgré les objections de diverse nature que cette innovation soulevait alors, il a su en faire triompher le principe; et, sous son impulsion, une première application a été bientôt réalisée sur une échelle grandiose dans la capitale de la France.

Or, quelque grand succès qu'ait obtenu cette belle application, quel qu'en ait été le retentissement, elle ne provoqua point d'imitations immédiates; et, en 1875, Belgrand pouvait encore écrire (*); "Paris " est la seule ville du monde qui ait adopté, pour sa distribution d'eau, " une *double canalisation*, destinée à séparer le *service public* du " *service privé.*"

C'est plus tard, et par l'effet de cette évolution si marquée de l'opinion publique en faveur des progrès de l'hygiène, que l'exemple parti de Paris est venu à porter ses fruits, que le principe de la double canalisation, désormais connu et apprécié, a trouvé des partisans convaincus, que d'autres applications ont été tentées et n'ont pas tardé à se multiplier, au point qu'en Allemagne les expressions *trinkwasser*, eau à boire, eau de boisson, et *nutzwasser*, eau industrielle ou d'usage ordinaire, sont devenues maintenant usuelles dans le langage de la technique courante.

Comme il arrive toujours, des préventions d'abord excessives ont fait place finalement à un enthousiasme exagéré; les avantages du dédoublement des distributions d'eau, niés ou contestés à l'origine, ont tout à coup paru si évidents que, pour certaines personnes, il n'est pas de procédé meilleur ou même équivalent pour l'alimentation des villes. Plus d'un spécialiste en est venu à proclamer, au nom de l'hygiène et comme un nouvel article de foi, que la *double canalisation* est le mode le plus satisfaisant de distribution d'eau dans les villes, et qu'on doit s'efforcer de le généraliser, de le mettre en œuvre toutes les fois qu'on le peut.

Je pense qu'il ne faut pas aller jusque là; et, en entrant dans quelques développements, je vais essayer de justifier mon appréciation, de montrer dans quelle mesure il convient de se tenir. Il m'a semblé

---

* Historique du Service des Eaux depuis l'année 1854. Note à M. le Préfet de la Seine. Dunod, 1875.

que j'avais d'autant plus qualité pour traiter la question devant le Congrès que d'une part j'y représente la ville où ce mode de distribution a été pour la première fois systématiquement adopté et a donné lieu à l'application la plus heureuse et la plus considérable, et que d'autre part, ayant eu moi-même à diriger dans cette ville le service des eaux, j'ai pu me rendre compte personnellement par une expérience directe de sa valeur réelle dans la pratique.

La *double canalisation* présente *deux avantages* certains :

1°. *Réduction au minimum de la quantité d'eau pure et salubre* nécessaire pour répondre aux besoins de la population ;

2°. *Amélioration du service aux étages des maisons*, rendu indépendant de celui de la rue.

De ces deux avantages le second est particulièrement sensible et précieux dans une ville comme Paris, où le *service public* est très développé et les constructions fort élevées; avec une distribution à *réseau unique*, l'ouverture simultanée des orifices à gros débit répartis en grand nombre sur la voie publique, ferait tomber à certaines heures la pression tellement bas que l'eau n'arriverait plus aux étages des maisons.

Mais c'est le premier qui est le plus souvent recherché parce que cet énorme développement du service de la rue, qui est la caractéristique de la distribution d'eau de Paris, est encore une exception pour ainsi dire unique. La *séparation des deux services* permet surtout le départ de deux ordres de besoins très différents et donne le moyen de limiter strictement la consommation de l'eau potable à ceux d'entre eux qui la réclament impérieusement. Dès lors on peut réduire considérablement le volume d'eau potable qu'il faut se procurer pour une ville donnée et par là même tourner les difficultés parfois très graves que présente le problème de l'alimentation de cette ville, ou réaliser une solution qui lui procure une économie importante.

Je n'ai garde de contester ces avantages qui sont assurément très réels ; je les apprécie hautement au contraire ; mais, quel qu'en soit le prix, ils ne vont pas jusqu'à m'aveugler au point de ne pas apercevoir d'autre part les *inconvénients* inhérents au *système de la double canalisation*, qui dans certains cas sont tels qu'ils compensent et au-delà ces avantages.

On ne peut nier en effet que le *dédoublement* de la distribution, l'obligation de poser deux conduites au lieu d'une dans chaque rue, de créer deux réseaux complets avec leurs accessoires, robinets, regards, ventouses, décharges, etc. ne soit une *complication* sérieuse. En doublant le développement des conduites, en augmentant de beaucoup le nombre des appareils de distribution, de contrôle et de sûreté, on accroît les difficultés de l'installation première, et surtout on crée pour l'exploitation des sujétions considérables, car les erreurs, les confusions, les fausses manœuvres, toujours possibles, appellent une surveillance plus minutieuse. L'organisation devient plus complexe, implique une direction plus attentive et plus exercée. De sorte que si l'on trouve des facilités particulières au point de vue de l'alimentation, par contre on

est contraint d'admettre dans la distribution des dispositions qui peuvent aisément faire perdre le bénéfice qu'on avait cru obtenir.

Ces dispositions plus compliquées ne vont pas d'ailleurs sans surcroît de dépenses. Il en coûtera plus assurément pour distribuer une même quantité d'eau au moyen de deux conduites qu'avec une seule. Cela se conçoit sans peine, et c'est d'autant plus vrai qu'il y a une limite inférieure au-dessous de laquelle on ne saurait descendre dans la fixation du diamètre des conduites qui font le service courant. Toute sujétion, toute exigence nouvelle dans l'exploitation implique aussi un personnel plus nombreux ou plus exercé et des frais plus considérables. Et il peut fort bien arriver aussi que les économies à réaliser sur l'alimentation par ce dédoublement du service soient absorbées et au-delà par les augmentations correspondantes de dépenses dans la distribution, surtout si l'on tient compte de la capitalisation des frais annuels.

Enfin, et par-dessus tout, il faut signaler un inconvénient très grave du dédoublement de la distribution, c'est la *confusion* possible entre *deux eaux d'inégale qualité.* Il n'est pas douteux qu'au point de vue de l'hygiène, et s'il n'est pas pris de précautions spéciales pour y parer, ce ne soit une objection très sérieuse. Cette considération est de nature à fixer plus particulièrement l'attention du Congrès. Partout, en effet, où l'on mettra simultanément les deux eaux différentes à la portée du consommateur, quelle garantie a-t-on qu'il saura toujours faire un emploi judicieux de l'une ou de l'autre suivant le cas? Et, si l'une d'elles est nuisible ou tout au moins suspecte, n'y a-t-il pas là un danger très grand, un manque absolu de sécurité? Prétendre le contraire serait se faire des *illusions* contre lesquelles s'élevait avec force et très justement, à la date du 20 Décembre 1889, le savant Directeur de la Revue d'Hygiène*, M. le Docteur Vallin. S'imaginer qu'il serait bon de placer sur chaque évier, dans les habitations, deux robinets, un large et à grand débit fournissant *l'eau de qualité inférieure* pour la plus grande partie des usages, et l'autre tout petit délivrant *l'eau potable* presque goutte à goutte, c'est bien mal connaître la nature humaine. "Peut-on croire que dans la cuisine par exemple, disait " M. Vallin, les domestiques auront le soin de prendre à l'un des robinets " l'eau nécessaire aux lavages et à l'autre l'eau destinée à remplir les " carafes, à préparer les mets?"† Rien ne garantira que, pour gagner du temps, on ne puisera pas bien souvent au gros robinet de préférence au petit. C'est aussi méconnaître les enseignements de la pratique; " dans les casernes, dit encore M. Vallin, quelque soin qu'on prenne " d'inscrire en grosses lettres au-dessus d'un robinet d'eau de source: " *eau bonne à boire*, et au-dessus des robinets ou tuyaux desservant les " puits: *eau dangereuse à boire*, on voit constamment les soldats gas- " piller indistinctement la première pour les usages externes et boire la " seconde, surtout si celle-ci est plus fraîche que l'autre de quelques " degrès";‡ et cette observation est confirmée par M. Letulle qui nous apprend que, "malgré l'existence d'une *double canalisation* dans les

* Paris. Masson, éditeur.

† Revue d'hygiène, 20 Décembre 1889, page 1053.

‡ Revue d'hygiène, 20 Décembre 1889, page 1052.

" hôpitaux de Paris, les serviteurs puisent indifféremment au robinet " *d'eau de rivière* et au robinet *d'eau de source.**"

Ainsi donc un système de distribution qui met deux eaux, dont une de qualité médiocre, à la portée des consommateurs, ne présente pas les garanties voulues au point de vue de la santé publique. N'en ressort-il pas à l'évidence cette conclusion, que j'énonçais déjà le 27 Novembre 1889 devant la Société de Médecine publique et d'hygiène professionnelle, à savoir que "*l'idéal d'une distribution d'eau c'est* " *l'alimentation unique*, avec un seul réseau de conduites, fournissant " partout en abondance une eau de bonne qualité, pure, salubre, à " l'abri de tout soupçon; de la sorte, en quelque point qu'on la puise, " on n'a pas de crainte à concevoir, on peut la consommer sans hésita- " tion et sans arrière pensée."† Et je crois pouvoir répéter ici ce que j'écrivais en 1888 : "Malgré la multiplicité des besoins et la diversité " des conditions parfois contradictoires qui s'imposent lors de l'éta- " blissement d'une distribution d'eau, c'est le système de *l'alimentation* " *unique* qui doit être ordinairement préféré."‡

Je n'entends nullement par là, je m'empresse de le déclarer condamner le système de la *double canalisation.* Mais je veux le restreindre à son vrai rôle, le ramener à ce qu'il doi être, c'est-à-dire un *expédient*, souvent fort utile, hautement recommandable à défaut de solution meilleure et capable de rendre dans certains cas de précieux services. J'ajouterai qu'il convient plutôt aux grandes villes où l'alimentation soulève des problèmes parfois très ardus et provoque des dépenses énormes, sur lesquelles il permet souvent de faire des économies importantes; tandis que, dans les petites villes, où la simplicité la plus grande, la rusticité des installations doit être la règle, il y a lieu de préférer la *distribution unique* parce que les besoins y sont plus faciles à satisfaire, parce que surtout on n'y aura jamais la garantie d'une organisation bien agencée, d'une administration sévère, intelligente et exercée, telle qu'on peut l'obtenir dans les grandes cités. Excellente à Paris où il serait absurde à coup sûr, pour l'éviter, d'aller chercher l'eau d'alimentation dans le lac de Genève ou celui de Neuchâtel, très recommandable encore dans les villes de premier et de deuxième ordre où "l'on est obligé de recourir à plusieurs sources " d'alimentation parce que aucune ne répondrait complètement à tous " les besoins, dans celles déjà partiellement desservies où il est devenu " nécessaire d'entreprendre des travaux complémentaires, dans celles " où les eaux qu'il est le plus facile de se procurer sont de qualité " inférieure et où l'eau pure ne peut être obtenue qu'à un prix élevé,"§ la double distribution devient très médiocre dans les villes de moindre importance, absolument irrationnelle et détestable dans les petites localités "quand on ne rencontre pas de difficultés extraordinaires

---

* Revue d'hygiène, 20 Décembre 1889, page 1053.

† Revue d'hygiène, 20 Décembre 1889, page 1058.

‡ Bechmann, Salubrité urbaine, Distributions d'eau, Assainissement. Paris 1888. Baudry, éditeur. Page 24.

§ Salubrité urbaine, Distributions d'eau, etc. Page 24.

" pour y fournir en quantité suffisante de l'eau de qualité acceptable, " ce qui est le cas le plus ordinaire."* Le choix entre les deux systèmes doit être "une question d'espèce: dans chaque cas, suivant " les circonstances locales et les conditions particulières, ce n'est " qu'après discussion des diverses solutions en présence que l'on peut " prendre la meilleure détermination."†

Enfin, dans les grandes villes mêmes, on ne doit pas perdre de vue le *danger d'une confusion possible* entre les deux eaux. En effet, s'il n'y a aucun inconvénient à laver les ruisseaux et les cours, arroser les rues et les jardins, alimenter les chaudières, etc., avec une eau qui, sans être insalubre, est impropre à la boisson, il faut empêcher qu'elle soit accessible aux habitants, si l'on veut avoir des garanties suffisantes, une sécurité complète au point de vue de la salubrité publique, et ne pas s'exposer à une *suspicion* constante, irrémédiable, qui péserait d'une manière fâcheuse sur la distribution tout entière. On n'y saurait parvenir qu'en *interdisant l'introduction de l'eau non potable dans les logements privés.* La double canalisation doit être limitée à la rue, ne pas pénétrer dans la maison. "Il convient, disions-nous déjà " en 1888, de ne délivrer dans les habitations qu'une seule nature " d'eau, afin d'éviter des confusions inévitables et fâcheuses pour les " usages domestiques; comment empêcher en effet d'une manière " efficace l'emploi de l'une des eaux pour la boisson si elles sont toutes " deux à la portée de la main ? "‡

Le rôle de *l'eau de seconde qualité* sera encore assez grand si on a charge d'assurer le *service public*, qui absorbe à Paris plus de la moitié de la consommation totale, et le *service industriel*, extrêmement développé dans certaines régions. On pourra d'ailleurs, moyennant des précautions particulières, l'introduire en même temps que l'eau potable dans quelques grands établissements, où la canalisation sera établie à cet effet dans des conditions spéciales et la surveillance organisée par une direction ferme et sévère de manière à donner toutes garanties. Encore conviendra-t-il, pour que la sécurité y soit absolue, de donner aux conduites et aux orifices fournissant l'eau non potable un aspect distinct qui les signale à l'attention générale et prévienne les erreurs, et des formes telles qu'il soit difficile d'y puiser l'eau pour la boisson. "A Paris on a pu sans inconvénient réel pousser parfois " jusque dans les maisons la *double canalisation*, et il est beaucoup " d'immeubles pourvus à la fois de *l'eau de source* et de *l'eau de* " *rivière*, sans que la confusion y soit possible; grâce à la *différence* " *de pression* des deux services, l'une des deux eaux se trouve " forcément réservée aux usages des écuries, remises, cours, etc., et " l'autre, atteignant seule les étages supérieurs, dessert nécessairement " les cuisines, cabinets de toilette, etc."§ Mais il faut considérer ces cas spéciaux comme des *exceptions*, éviter de les multiplier, et s'écarter

---

* Bechmann, Salubrité urbaine, Distributions d'eau, etc. Page 24.

† Bechmann, Salubrité urbaine, Distributions d'eau, etc. Page 25.

‡ Bechmann, Salubrité urbaine, Distributions d'eau, etc. Pages 135.

§ Bechmann, Salubrité urbaine, Distributions d'eau, etc. Pages 135 et 136.

le moins possible de la *règle* qui proscrit le dédoublement de la canalisation intérieure dans les habitations.

Nous pensons que les considérations qui précèdent justifient amplement les conclusions que nous proposons de soumettre au vote du Congrès et qui seraient formulées comme suit :—

I.—*Pour le service d'eau d'une ville l'idéal est la distribution unique d'eau potable affectée à tous les usages.*

II.—*Lorsque des circonstances particulières obligent à recourir à l'expédient d'une distribution double fournissant deux eaux de nature différente, dont une seule est potable, par des canalisations distinctes, il faut éviter d'étendre le dédoublement de la canalisation dans les logements privés où l'eau potable seule doit être mise à la portée des consommateurs.*

The Separate Water Supplies for Domestic and for Sanitary Purposes at Southampton.

BY

WM. MATTHEWS, Mem. Inst. C.E., F.G.S.

Until 1852 the town of Southampton depended for its water supply upon the surface drainage from the Common and adjacent lands, which was collected and stored in two reservoirs situated on the Common, at a level of about 60 feet above the town, and holding together 5,000,000 gallons.

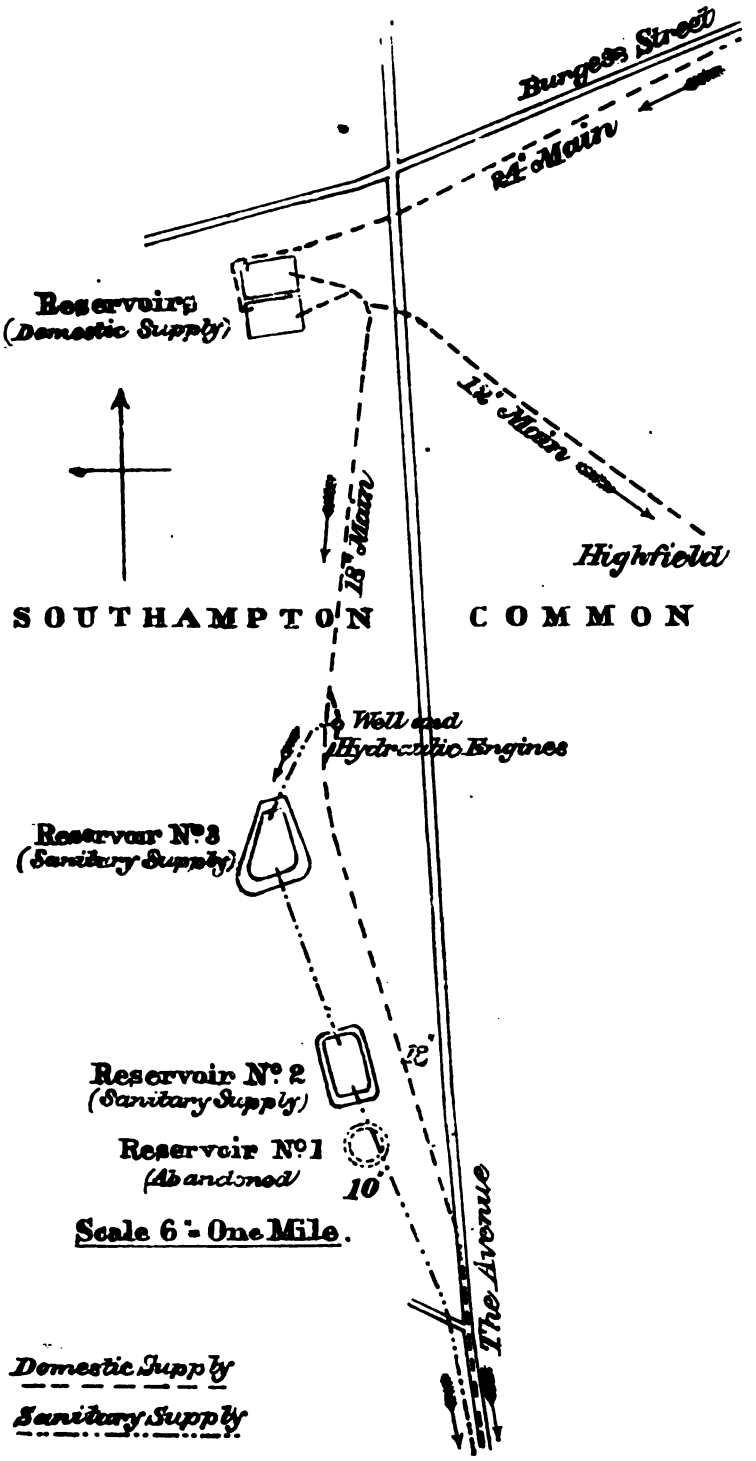
A well and boring was also sunk near the upper of these reservoirs, with the object of obtaining water from the chalk. The scheme was, however, a complete failure, and the boring was abandoned at a depth of 1,317 feet, after having involved an expenditure of over 20,000*l.*, and yielded less than 100,000 gallons per day of water of indifferent quality.

A supply pumped from the River Itchen was introduced in 1852, and remained in use until 1888, when new works were established, drawing a supply from wells sunk in the chalk, eight miles to the north of Southampton.

The water from this source is abundant and of great purity, but somewhat hard, and to remove this hardness a softening process has been adopted with great success, the working expenses being less than ¼*d.* per 1,000 gallons.

This water is delivered partly direct to the town and partly into reservoirs situated at the top of the Common, 160 feet above the town, and holding 5,000,000 gallons.

The foregoing constitutes the domestic supply, and is distributed throughout the town in the usual manner.


Burgess Street
24" Main
Reservoirs
(Domestic Supply)
18" Main
18" Main
Highfield
SOUTHAMPTON COMMON
Well and
Hydraulic Engines
Reservoir No. 3
(Sanitary Supply)
Reservoir No. 2
(Sanitary Supply)
Reservoir No. 1
(Abandoned)
10
Scale 6" = One Mile.
The Avenue
Domestic Supply
Sanitary Supply

For many years prior to 1888 the water collected from the drainage of the Common had been suffered to run to waste, but upon the new works being initiated the author drew up a scheme whereby this water could be used for sanitary purposes, and a saving be effected in the consumption of that from the new works, which had to be pumped and softened at considerable cost.

A line of pipes was already in existence, leading from the two old reservoirs for some distance into the town, and this was put in working order and utilised as the main supply for 'sanitary' purposes from these reservoirs. There were also duplicate mains in some streets which were quite unnecessary, and these were severed from the domestic supply and connected with the sanitary supply.

About this time, too, it became necessary, owing to the increased pressure of water arising from the abatement of waste, to renew the pipes in a great number of streets, and as the sanitary supply was arranged to work under a much lower pressure, the old pipe lines, instead of being removed, were incorporated in the sanitary supply system; and gradually, as this work of renewing mains goes on, the sanitary system will be spread all over the town. At the present time there are nearly seven miles of such mains, and over one-third of the roads in the town are now watered from this supply.

This water is used exclusively for public purposes, such as road watering, sewer flushing, to urinals and the like, no connexions being made with houses under any circumstances.

In very dry weather it is found that the drainage from the Common is insufficient for the sanitary supply, and to meet any unusual demand an auxiliary supply has been established.

The deep well on the Common, as before stated, yields from 90,000 to 100,000 gallons per day, and this is pumped up by hydraulic engines working a set of well pumps and delivered into the sanitary reservoirs. Power to drive the engines is obtained from the 18″ high-pressure domestic supply main, which passes close to the well on its way from the reservoirs at the top of the Common to the town.

An 8″ by-pass is fitted to the 18″ main, and the engines work on the by-pass. The water is admitted at a pressure of 20 lbs. to the square inch, and exhausted into the main at a pressure of 5 lbs. to the square inch. No water is thereby lost, and the loss of pressure in the main is of no consequence, as the full pressure is more than is required, and the engines are only at work for a few hours each day in dry weather.

Secondary supplies have not been adopted in many towns in this country, and then chiefly in connexion with sea-water supply; but the author is of opinion that in many places there exist supplies which, although unfit for domestic purposes, might be obtained by gravity at little cost, and by the judicious use of existing mains distributed as a supply for sanitary purposes, as has been done in Southampton, at a trifling expense. One great benefit which arises from the presence of a separate and cheap supply is that there is less tendency to be sparing in the use of water for sanitary purposes; whereas when the

water used for these purposes has to be pumped and distributed at considerable cost, the great object of the authorities is to reduce the consumption to a minimum.

DISCUSSION.

Mons. P. A. Maignen said it appeared that they were all agreed in thinking that water must be pure, and the question they were dealing with was how to render pure that which was impure. Mr. Binnie had said that one ought to have a pure water-supply. But they ought to understand what pure water meant. They might go to a considerable expense to bring to a town what was called pure water, and then, after the expense had been incurred, find that it was very impure. For example, at a congress in Brussels it was intended to fix at 30° per litre the quantity of inorganic matter, namely, lime, to be tolerated in water. Several members of the congress asked, if 30° were fixed as the quantity of lime in water, what they would do in that town where they had 35°? If the Government would not allow them to have that water, they would have no water at all. It was ultimately considered that water might be permitted by the Government if it held as much as 50° of inorganic matter. He protested, however, against water containing that amount of calcareous matter in solution being used. He had lately been greatly struck by the deleterious influence of hard water as a cause of gout and of arthritic diseases. The second point on which he desired to speak was that mentioned in the paper of M. Bechmann and in the paper on the water-supply of Southampton. It appeared to him that the assumption had been made that they could not purify water, that it was absolutely necessary to have bad water and good water. He thought, however, that if, in these days of science, they remained with their arms crossed, and declared that they would not attempt to purify water, such an attitude was unworthy of that great assembly. He, therefore, proposed that attention should be drawn to the mode of purifying impure water, for he held that it would be cheaper to purify the worst water of the Thames and the worst water of the Seine, for the whole supply of London and the whole supply of Paris, than to have a double canalisation and the drawbacks attached to it.

Professor Robinson said he agreed very strongly with the remarks of Mr. Binnie as to the undesirability of depending entirely upon the filtration of water, inasmuch as the recent observations of chemists and biologists had proved conclusively that certain organisms were not destroyed or arrested by the passage of water through sand *per se*. Nevertheless, he thought they ought not to be alarmists in what they said in that room. Many large communities had taken, and would in future take, their water-supply from sources which were practically subject to slight pollution, and it was true that if that pollution was of a nature to cause the conveyance of cholera-germs, no doubt a certain risk must be run; but they ought to avoid expressing any very alarmist views in that direction. It had been stated that running streams purified themselves. That was true to a very large extent; but it was desirable to bear in mind that, in the metropolis, although they had a low death-rate, they ought not to attribute it entirely to the fact of London drawing its water-

supply from the Thames, for he believed it was still more due to the sanitary precautions, the excellent scavenging arrangements, the hygienic provisions made in the houses of the poorer classes, and all the other sanitary measures that were now so well recognised as essential. It ought not, therefore, to go abroad that the supply of water to London from the Thames was the only cause of the low death-rate. He believed that a large number of persons did exactly as he did in his own house, where cisterns had to be used, *viz.*, not to allow any water to be drunk without its being filtered. By a constant supply, one of the chief causes of mischief would be obviated. He thought the question of intermittent and constant supply deserved to be brought before the Section. It ought, in his opinion, to be made compulsory that each house should have a supply of water without having to store it in cisterns. In the houses of the well-to-do and educated classes, the mischief of storing any sort of water was well recognised, and no drinking water should be drunk without passing through a filter after coming from the cistern; but amongst the poorer classes, who form the larger number of the inhabitants of London—those who lived in the smaller houses—in spite of the precautions that were taken by inspectors of nuisances and by the excellent officials acting under the vestries, the state of things was very different, and it was impossible to over-estimate the mischief arising from the cisterns and stores of water to be found in such houses. He had referred in his paper to a subject on which he hoped th Congress would hear something from Dr. Frankland, viz., to a very interesting experiment made in America by the State Board of Health of Massachusetts.* It was an interesting experiment on a very large scale, extending over a long period of time, and it showed conclusively that some bacteria absolutely passed through sand filters without any injury whatever, coming out perfectly healthy, and active for future mischief. He could confirm what Mr. Binnie had stated, to the effect that sand-filtration alone could not be relied upon for the perfect purification of water, but there were means of purifying water by using a form of filter like the iron filter of Dr. Anderson, and also several other forms of filter. At all events, there were certain compounds which appeared clearly to have the power of destroying all bacteriological life. Therefore, when engineers had to deal with the filtration of impure water, it should be remembered that the old sand filter might be improved upon. With regard to the duplicate water-supply—an impure supply for "sanitary" purposes, and a pure supply for domestic purposes—that was an ideal arrangement carried out successfully at Southampton, and was proposed many years ago by Sir Joseph Bazalgette to be applied to London, but the practical difficulties in the way caused the withdrawal of that scheme. The idea was an excellent one, and the author of one of the French papers had laid down some very good conclusions on the subject, to the effect that it was desirable, if they could, to use impure water where pure water was wasted; but he was afraid that there were practical engineering difficulties in the way of doing it on a large scale or in large towns, and he thought, therefore, from a practical point of view, that it was not capable of being carried out.

Dr. Edward Frankland said they were all agreed that amongst the conditions necessary for the maintenance of a satisfactory hygienic condition in towns, a supply of pure water was, perhaps, the most important of all. The attention of hygienists had been more and more directed of late years to water, inasmuch as the guilt of sewer-gas in the propagation

of epidemic disease had been more and more diminished. The more numerous the investigations that were made into the sources of infection in such cases, the more clearly did it appear that the infectious matter was not, or only in very exceptional cases, capable of being conveyed by sewer-gas. The reason was not far to seek. The infectious matter, as they now knew, but did not formerly know, must be solid, it was a living organism, and no living organism could consist either of liquid or of gas, it must be solid; and numerous and satisfactory experiments had shown that it was with extreme difficulty that a solid, or, for that matter, a liquid, could be suspended in the gaseous atmosphere of a sewer. They might agitate sewage or any liquid in the most violent way with atmospheric air, and yet they could prove, by the most delicate tests, that none of the liquid was carried more than a foot or two from the surface. It was, however, different when there was a gas generated in the liquid. The minute gas bubbles seemed to have the effect of buoying up, like so many small balloons, the particles of liquid in which they were generated, and if there were minute solids like the spores of organisms in that liquid, it was obvious that they would be carried along with it, and in that way, no doubt, infection could be conveyed by means of the air. But unless they had very badly constructed sewers in which the sewage was undergoing active fermentation, it was impossible to conceive that such an evolution of gas as that would take place. Indeed, the result of laboratory experiments had of late been confirmed by Professor Carnelly and others, who had found that sewer-gas was much freer from suspended organisms than the ordinary atmosphere which they breathed. There was probably at that moment a thousand-fold more organisms in the air of the room in which they were assembled than in a corresponding quantity of air in the sewers beneath their feet. Their attention had accordingly been directed more and more to liquids, and especially to water, for the propagation of epidemic disease. It was pretty well known that developed bacteria were very soon killed in flowing water, and, therefore, that those developed organisms could not exist for any length of time in river water. On the other hand, the spores of bacteria were not killed by a very prolonged contact with running water; and as those spores were capable of development and were exceedingly small, they were the dangerous bodies to which they had to look. Much had been said about the purification of rivers and of water-supplies by oxidation; and he had seen many very beautiful cascades at water works by which it was sought to aërate, and consequently to purify, the water. He did not, however, believe that those attempts at purification had any important effect, at all events in removing dead organic matter in solution in the water; but they certainly could not have any effect in killing the spores of which he had spoken; and that those spores passed through sand filters the experiments just related as having been made in America conclusively showed. They also passed through very great thicknesses of porous material, such as the old moraine of a glacier. There was an experiment upon a large scale made in Switzerland, to which Mr. Binnie had alluded in his valuable paper. A case of typhoid fever occurred in a valley called the Fühler Thal, separated from another valley containing a village by the old moraine of a glacier. The water supply of the village was derived from a spring known to come from the Fühler Thal on the other side of the moraine, through its porous material. A violent outbreak of typhoid fever occurred. The cause of it was very exhaustively investigated, and the dissemination of the infective material by a patient in the neighbouring valley was

1 p. 2205.

clearly made out. His clothes were washed in the stream which disappeared at a swallow hole and was afterwards proved to furnish the spring from which the village in the other valley was supplied. The people who drank the water from that spring were affected by typhoid fever, while those who had other sources of supply escaped entirely. But the value of that demonstration consisted in this:—it was clearly shown that by dissolving in the brook in which the patient's clothes were washed several hundredweights of common salt, the quantity in the spring water in the other valley immediately rose very much. Then a similar quantity of flour was carefully diffused in the water of the brook, which again disappeared in the swallow hole, but did not affect in the slightest degree the clearness of the spring water which was distributed in the village; conclusively showing that a filtration which was probably much better than any artificial sand filter failed to remove the typhoid germs, although it was perfectly effective in removing the minute starch granules of the flour. He desired to confirm the statement made by Mr. Binnie that chemistry could not tell whether the water was free from zymotic poisons. It could trace the history of the water; it could tell, at all events in many cases, most conclusively whether it had previously been contaminated with sewage, and even whether that had been long ago or recently; and he did not think that even now they could rely upon bacteriology as giving decisive evidence as to whether water was infected or not; for many experiments had been made in which waters artificially infected with typhoid had been examined, and the bacteriologist had failed to find the typhoid-germ present. It was, therefore, he thought, a matter of precaution at all events, to supply towns, as far as possible, with water which had never been contaminated with sewage. As to the methods of purification, he should listen attentively to the papers about to be read to the section, but he did not know at present of any certain method of purification, except boiling the water, and that, he thought, all engineers would agree was an impracticable thing with water to be supplied to a town. M. Bechmann had given the Congress a valuable opinion about a dual supply, on which he (Dr. Frankland) should like to say a word or two. As towns grew in population it obviously became more and more impossible to supply to them the enormous volumes of pure water which they required if they were to have one supply only. He had often thought of the possibility of supplying a drinking water and a water for "sanitary" and out of door purposes, the two being kept entirely separate. He saw clearly great difficulties in the way of such a system. The most obvious solution of the difficulty would be that which appeared to have been adopted in Southampton, and it would be interesting to know what were the relative volumes of the two waters in that town. But so far as he knew, the simple method which would suggest itself to everybody, that of having a supply for the outside and another for the inside, had this great disadvantage in the way of its adoption, that the outside water was, at all events in English towns, used in such comparatively small quantities that it was hardly worth considering. If they were to supply the inside wants of a house by a pure water they might almost as well supply the whole town with it. At all events that was the case with English towns. But he was quite sure it was very different in France, where, as M. Bechmann had stated, a large quantity of outside water was used for fountains and other purposes for which in England it was not required. But if there could be some contrivance by which the water for "sanitary" and other similar purposes could be supplied to the inside of houses without the possibility of people being

able to get at it for drinking, he thought that would be a great boon to large towns like London and Manchester, especially to London. How that was to be done he did not venture to suggest. It was an engineering question, but he could not think that it was impossible. They would then only require in London about one quarter or perhaps one fifth of the present supply for drinking and for dietetic purposes generally, the dietetic water being kept perfectly separate from the other, which latter might even be abstracted from the tidal reaches of the Thames.

Mr. Baldwin Latham said he did not at all dispute Mr. Binnie's facts that in India the effects produced by water-supply were not very deleterious, even when it was taken from rivers. In his paper he had given one remarkable instance where such a thing had occurred. But he believed that water supplied for domestic purposes should be of the greatest purity that it was possible to secure. He was not an advocate for taking water for the supply of towns from impure sources, but where there was no other source except that of a river, and where no serious objections had been shown to that source, it should not be discarded. It was better to have that water than none at all. It had been said that they ought not to judge of the health of London by its water-supply. That might be perfectly true, but, on the other hand, if the London water-supply was of that noxious character which so many people were so constantly preaching, surely it would be shown in the health statistics of the metropolis. What were the facts with regard to those particular diseases which were supposed to be due to impure water-supplies? The fever death-rate in London had been reduced from ·78 per thousand in 1868, to ·15 per thousand in 1890, in other words, to one fifth. No doubt that was due to progressive sanitary improvements, and also, probably, to the great improvements that had taken place in the establishments of the various water companies with regard to the supplying of much purer water than had been supplied in the previous years. So with regard to the zymotic death-rate in London, which in the last twenty years had been reduced by more than one-half. Those figures clearly showed that the water-supply could not have had any very noxious influence upon the health of the people. With regard to the facts which he had stated, as to the wonderful purifying power of water flowing down a river like the Ganges, they had been corroborated by the German Commission on Cholera, which laboured in India for a long period, Dr. Koch being one of its eminent members. It was conclusively shown that this purification in the water had taken place; and in one of the most remarkable cases they had ascribed it to the influence of long exposure to light. They had shown, by experiments, that many of the germs of disease were absolutely destroyed by such exposure. Now that exposure which took place in a river did not take place in underground water; and there was no doubt that underground waters, when once polluted, not being exposed to the beneficial influence of light, would carry the germinal matter of disease for miles underground. One instance of that had already been given. Last year he had to make, for the East Riding County Council, an investigation as to the outbreak of fever in Beverley. Beverley was supplied from a deep well in the chalk. It had been subject to repeated outbreaks of typhoid fever, and it had been shown, conclusively, by the medical officers of the Local Government Board, that these were traceable to the water-supply; but how that was brought about they had never been able clearly to demonstrate. Last year he made an examination of the district, after an outbreak of fever, and he found the whole of the sewage of a village,

and the stream into which it flowed, disappearing in a swallow-hole, two miles from the works. Subsequent chemical tests, by the use of lithia, showed that in the course of a single day the whole of that sewage must have gone through the ground into the water-supply. Therefore the fact was at once established that there was a direct connexion by sewage contamination between that water-supply and the cases of typhoid which had occurred. In that case the water travelled more than two miles underground. With regard to the question of dual water-supply:—If they could so manage the dual water-supply that, as in the case of Southampton, they did not permit the two supplies to be taken into any one house, or give the opportunity of taking the dirty and cheap water with the pure and expensive water, it was all very well. Even in London they had for years had a dual supply. The New River Company supplied, from the ponds at Hampstead, water for flushing sewers and watering roads, as distinct from the domestic supply, and many other towns had also used water in that way. Many seaside towns, for example, used sea water for the purpose of watering roads and flushing sewers. So long as it was confined to the mere question of dealing with works which were under the control of the sanitary authority, there could be no objection whatever to such a supply, but the moment they gave the consumer an opportunity of taking water from either one source or the other, they introduced an element of danger into the habitations of the people.

Herr Kümmel (speaking in German) said that the best system was to deliver one quality of water, but if that was not possible, to deliver to the consumers the best water only. But besides the quality of the water, they also had to consider the quantity of water to be supplied for domestic purposes at any hour of the day or night, without interruption Those who lived in large towns at a distance from mountains were not able to procure the water from the hills. They found that the ground-water very seldom existed in sufficient quantity for delivery to the consumers, and they had therefore to take the water from its own source. In the case of river water it was found to be contaminated by many towns above their own. That may have been occasioned by sewage, or by the superficial introduction of human excreta. There had been very little alteration in the construction and working of filter-beds for the last 40 years. But they probably might be able to introduce a valuable means in future. The presence of organic matters, which was formerly the only criterion of the quality of the water in the previous state of their knowledge, was not so important as the presence of bacteria. They now know that the bacteria lived on, and destroyed, the organic matter, and they therefore concluded that the quantity of organic matter was a condition favourable to the existence of a large number of bacteria; and that a trifling quantity was the condition for a small number. They ought to try and discover, as exactly as possible, the number of bacteria in the ordinary and in the filtered water, and to compare the conditions and working of the filters with regard to their effect in diminishing that number. If possible they should, at the same time, state the different kinds of bacteria that were present. That was a very important but a very difficult matter. If all the engineers engaged in filtration would endeavour to ascertain the best way of diminishing the number of the different kinds of bacteria, and to avoid the presence of more than from 25 to 30 bacteria per cubic centimetre, even with a number of 24,400 per cubic centimetre in the river water, he was sure that they could purify the river water, polluted by domestic drainage, in such a way that they

could deliver a good, potable, and safe water to their customers. But then they must not believe that they had fulfilled their duty when they had worked their filters as well as possible, leaving the rest to God and to good fortune.

Dr. William Odling said that if they took pure river water and contaminated it purposely with sewage, and attempted to oxidize that sewage by passing a current of air through it, or by some similar process, they obtained practically negative results. They saw, in a great number of cases, that there was an absence of purification; and the observation of that fact, together with the non-observation of facts of an entirely different character, had led some chemists to maintain that the self-purifying power of water was exceedingly small, that it was, in fact, a negligible quantity. The facts remained as they were, but the view had entirely altered, because it had been found that, under suitable conditions, the oxidizing power of river water upon sewage matter was simply enormous. It was not a question of a few grains or a few per-cents., but of hundreds and hundreds of tons of oxygen consumed in the destruction of the matter discharged into running water. That was a point that was admitted. That, of course, referred to dead organic matter. Next came the question of living matter, which they might speak of generally under the name of microbes. In the present state of their knowledge, it might be said that the microbes in the main existed both in their developed form and in the form of spores. In the developed form they multiplied with extraordinary rapidity. In the form of spores, so long as they continued in that form, each egg remained an egg only. Then another point had been established, that the objectionable microbes, in their fully developed state as discharged into running water, could not exist, could not multiply, and rapidly disappeared. It then only remained a question of the spores. It appeared that some could exist for a considerable length of time in river water. Some, among whom was Dr. Frankland, argued the question in this way: that no matter what the extent of dilution, now and then an individual would chance to take a spore, and would suffer for it. With regard to the chance, it was extremely small. He had made a calculation that, if so many million spores were taken into the Thames, say at Oxford, the chance of a person getting one of them at Teddington Lock would be something like the chance of getting one single spore from drinking some hundreds of gallons of water. That was a point—he thought the only one—on which some of them were at issue with Dr. Frankland, whose view was that, because a single spore put into a sterilized jelly would almost certainly develop itself, and from that would proceed an infinite multiplication of the microbe, the same thing took place in the animal body. He (Dr. Odling) contended that all the evidence went to show that that was not the fact; the animal body had a definite power of preventing the development of those objectionable microbes, and it was only when they amounted to a quantity beyond that which the animal body was capable of dealing with, that they became dangerous. For his own part, he should have no objection to taking one microbe-spore every day of his life, without any fear of having his life thereby shortened.

The President said that he was sure the members of the section would join him in congratulations to Dr. Odling on the highly interesting information he had afforded.

M. Bechmann (*speaking in French*) said, he only wished to offer a word or two in reply to the observations which had been made on the subject of his communication. He thought that no one had contradicted

his first proposition, that the ideal distribution of water was a single distribution. It was said that it was better to purify water by filtration than to distribute two kinds of water, but that was no contradiction to the proposition he had put forth. Purification and filtration were but the means of obtaining the distribution of a single supply. In opposition to his second proposition, it had been stated that by renouncing the idea of introducing two kinds of water into the interior of houses, he too much reduced the rôle of the water supplied outside; in London, for example, the great part of the consumption was in the interior of the houses. That objection had been made by Dr. Frankland. It should be remembered, however, that in Paris a large quantity of water was required for the streets, the public fountains, and the like, for what was known as the public service; there was also a large quantity required for industrial purposes, altogether more than 130 litres per head. With regard to the introduction of a dual supply, it was only proposed to have one kind of water for the interior of a house. The amount of that water provided was 140,000,000 cubic metres for a population of 2,400,000, amounting to 60 litres, or between 13 and 14 gallons per head. That, however, was admitted to be insufficient, and works were being executed, and would probably be completed in two years, for the supply of 100,000 cubic metres more, in all 240,000,000, or 100 litres per head. That was for domestic use only, and he thought that 20 gallons per head was a very respectable quantity, and perfectly sufficient for the service of the interior of houses.

Mr. A. R. Binnie said, with regard to the remarks that had been made on the subject of the calcareous impurities in water, he thought that the subject of hard and soft water had been pretty well discussed in this country for many years past. They were gradually arriving at the conclusion that unless the water was excessively hard—by that he meant something over 25° or 30° of hardness—the mere presence of calcareous matter in the water was not detrimental to health. On the other hand, if water was required for manufacturing purposes, the question of softness became absolutely essential. Speaking of water, it would be observed that the words he had used in the paper were, "A good supply, and a supply unimpeachable on the question of purity." A supply might be very good in the sense of chemical analysis, but might not, from his point of view, be a good and pure supply. He always disconnected the two things in his own mind, because of the fact which had been emphasised by those who were much more able to speak on the subject than himself, that chemical analysis, in its present state, was not able to tell them the whole history of the water. On the subject of duplicate supplies in towns, he thought that the matter would require considerably more investigation before the system could be applied to very large places. He could quite understand, in the case of Southampton, that the circumstance of the old pipes existing in the town lent itself to an economical introduction of a new supply. But what did they find in that particular case to be the outcome of the duplicate supply? They found that the houses were supplied in their entirety; that the interiors of the houses were supplied with potable water, water for washing, and for water closets, and that the only saving ultimately effected by the introduction of the duplicate supply in that case was for absolute "sanitary" purposes out of doors, such as flushing sewers and urinals, watering roads, and the like. So that he did not see, putting it on that limited ground, that there was much to be gained from a duplicate supply. On the other hand, looking at the expense, and to what it would

cost for each house, and to the possible danger where the entire supply was of a very inferior quality, he hardly thought that the subject had been sufficiently investigated to warrant them in pronouncing any decided opinion upon it. With regard to Professor Robinson's remark about a constant supply, he thought they had all made up their minds on that subject—that the supply should be constant. He could not imagine, in the year 1891, anyone advocating an intermittent water-supply. With respect to sand-filtration, after what they had heard from their friends the chemists, they could not, as engineers, say absolutely that sand-filtration was the end of everything. Mr. Baldwin Latham and himself appeared to be very much at issue with regard to the water-supply of India. He was sorry to differ from that gentleman *in toto*. He had lived for six years in India, and nothing had impressed itself upon his mind so much as the fearful effect on the health of India produced by the drinking of water from rivers. When cholera, as it often did, broke out in the Great Hurdwar Fair, which was held near one of the main sources of the Ganges, it swept down the Gangetic valley, and decimated the people who drank the water in all directions. It was a matter of history, and it did not require him to assert the fact that cholera outbreaks in India were clearly traceable all down the Gangetic valley. They might take the case of a town in which cholera had become epidemic within the memory of man, and was never known to be absent. During the six years previous to the new works being constructed, people had died to the number of 1,264 out of a population of 84,000. They then introduced the new water-supply. The old supply was obtained from a reservoir or large tank, the water flowing into which was derived from a more or less populated drainage area. The new works were not very far distant from the town. The drainage area was perfectly pure. There was one village in the drainage area which was bought up, and the people were transferred to another district. The effect in the first six years after the introduction of that supply was to reduce the total number of deaths from cholera to 177, and of those deaths they had every reason to believe that a large proportion were imported from the districts immediately surrounding the city. There was no drainage to complicate the question. The town was undrained before, and it remained undrained to the present day.

L'Hygiène des Chemins de fer et des Voyageurs.

PAR

Le docteur Louis de Csatáry, Conseiller du Conseil général d'hygiène publique de Hongrie, Inspecteur en chef du service de Santé des Chemins de fer R. de l'Etat hongrois.

J'ai eu l'honneur de traiter la question de l'hygiène des chemins de fer et des voyageurs dans les congrès internationaux de Vienne et de Berlin.

Mes conclusions furent acceptées à Vienne à l'unanimité des voix.

La section d'hygiène du Congrès international de Berlin reconnut l'importance de mes propositions et fut d'avis qu'il sera utile de discuter les thèses spéciales dans une prochaine réunion.

Je suis très heureux de pouvoir soumettre mon ouvrage, le fruit des études et de l'expérience de 32 années, au jugement des ingénieurs et des hygiènistes de toutes les nations réunis en Angleterre, le berceau et la véritable patrie de l'application de la vapeur et des principes de l'hygiène en général.

L'hygiène des voyageurs est en relation directe avec celle des chemins de fer en général; le voyageur ne pourra conserver sa santé si les institutions des grandes voies de circulation ne sont pas conformes aux principes reconnus de l'hygiène.

Ces grandes voies sont représentées sur la terre ferme par les chemins de fer et les tramways.

Le Ministre du Commerce hongrois M. de Baross introduisant le tarif des zones, a augmenté le nombre des voyageurs dans des proportions gigantesques; son œuvre philanthropique est un des plus utiles bienfaits que l'on puisse rendre à l'humanité; le prix minime des voyages les plus éloignés donne au plus pauvre la possibilité de changer son domicile; ce penny système des voyages est aussi de grande importance pour l'avancement des sciences, des arts et de l'industrie; il est facile de prévoir que ce système bienfaisant à toute l'humanité sera adopté tôt ou tard par toutes les nations civilisées.

Mais avec le nombre croissant des voyageurs il est nécessaire de subvenir aux exigences de leur santé et de leur sûreté en voyage; il faudra prendre des mesures utiles pour protéger non seulement les voyageurs, mais aussi le personnel de service contre les influences nuisibles de la locomotion rapide sur les voies ferrées.

Les mesures à prendre se rapportent :—

1. Aux conditions hygiéniques des bâtiments et des moyens de transport.
2. Aux moyens de secours et de sauvetage en cas d'accidents et de maladie en temps de paix comme en temps de guerre.
3. Aux conditions hygiéniques du service du personnel employé.
4. À l'emploi d'un nombre suffisant de médecins pour le secours des employés et des voyageurs.

I.—Bâtiments et moyens de transport.

Tout bâtiment doit être construit selon les règles hygiéniques.

Il est donc nécessaire que l'inspection hygiénique des bâtiments et des gares soit faite par le médecin expert qui doit prendre part à la commission technique déléguée lors de l'enquête d'exploitation pour examiner les chemins de fer avant leur ouverture.

À cette occasion le chef du service de santé est obligé d'examiner les conditions hygiéniques des bâtiments de toute espèce, des gares et des eaux potables.

Il est absolument nécessaire que l'emplacement des gares soit assez large; dans le cas contraire le personnel de service est exposé aux plus

grands dangers; dans les gares étroites il y a toujours beaucoup d'accidents causant la mort et les graves blessures des employés.

L'encombrement des employés dans les bureaux et des ouvriers dans les usines est nuisible à la santé; tous ces locaux doivent être spacieux et bien aérés.

Il serait utile de soumettre les plans de construction à l'avis du chef du service de santé pour éviter des fautes commises contre les règles de l'hygiène.

La construction des wagons doit présenter au voyageur la sûreté et le confort sans aucune distinction des différentes classes.

Les places ne pourront pas être étroites, car en ce cas elles sont nuisibles, surtout aux voyageurs de longue route obligés de rester longtemps dans une position incommode.

Il est contraire aux principes de l'hygiène de faire distinction des sièges selon les classes des voitures, car le voyageur de troisième classe a besoin de place suffisante aussi bien que celui qui, plus favorisé par le sort, peut voyager en seconde ou en première classe.

L'utilisation des places est parfaitement juste et le grand nombre de voyageurs la rend inévitable, mais d'autre part il est aussi nécessaire de subvenir aux besoins du public.

La ventilation, l'éclairage et le chauffage des voitures exigent aussi des notions hygiéniques.

La ventilation peut se faire sans aucune difficulté par l'abaissement des fenêtres; on peut aussi écarter les fenêtres de leurs châssis pour éviter tout courant d'air, comme j'ai introduit cette méthode dans la voiture de sauvetage, construite selon mes plans, et exposée à la grande exposition d'hygiène de Berlin de 1883.

Chaque voiture doit être ventilée par l'ouverture de toutes les fenêtres cinq minutes avant la réception des voyageurs.

Tout voyageur a fait l'expérience des désagréments causés par le défaut de la ventilation en entrant dans une voiture chauffée artificiellement ou en été par le soleil.

Le chauffage des voitures est soumis à de grandes difficultés et jusqu'à présent nous ne connoissons pas une méthode parfaite.

Les appareils de circulation à air chaud, à vapeur ou à eau chaude ne permettent pas de tempérer convenablement les degrés de chaleur et sont souvent la cause d'odeurs désagréables.

D'autre part les voyageurs n'ont pas l'habitude de se pourvoir avec des habits assez chauds, même en hiver, car ils croient avec raison que ce n'est pas nécessaire dans les voitures chauffées; en abandonnant la voiture ils se refroidissent très-facilement et sont exposés à de graves maladies.

Selon mon expérience l'unique méthode par laquelle la chaleur peut être maintenue et tempérée consiste dans l'application de fourneaux.

L'éclairage doit être assez fort pour que le voyageur puisse lire sans aucune difficulté, ce qu'on ne trouve pas en général dans la plus grande partie des voitures en usage; la lumière insuffisante gâte les yeux des liseurs.

Il serait nécessaire selon les exigences de l'hygiène d'employer partout l'électricité pour l'éclairage suffisant des voitures.

Il est aussi de grande importance que la construction des wagons amoindrisse par sa résistance les suites des accidents, et surtout que les voyageurs puissent se sauver assez vite des dangers prévus.

Dans ce but les portes des wagons doivent être facilement accessibles et faciles à ouvrir.

On a introduit depuis quelques années des wagons avec des couloirs latéraux, munis seulement de deux portes aux extrémités des couloirs; ces wagons représentent les plus grands dangers en cas d'accident, car il est impossible d'atteindre par le couloir étroit les portes pour se sauver et même il est très-difficile de circuler, d'entrer ou de sortir de ces couloirs même quand il n'y a pas de danger.

La plus grande propreté doit être maintenue dans tous les wagons, les réservoirs doivent contenir en été comme en hiver une quantité suffisante d'eau fraîche

En hiver il faut introduire dans ces réservoirs de la vapeur chaude pour empêcher que l'eau gèle.

L'introduction des wagons-lits est un grand bienfait pour les voyageurs, mais il est à désirer, pour des raisons hygiéniques, que les couloirs latéraux soient plus larges, que l'on n'applique pas les lits l'un au-dessus de l'autre, et que les cabinets de toilette soient partout séparés des closets.

Les wagons employés sur les tramways doivent être construits selon les mêmes règles de l'hygiène; il faut surtout éviter l'encombrement des voyageurs qui favorise l'indécence et tend à propager les maladies contagieuses.

Pour cette raison il ne faudra pas imiter l'institution des tramways de Vienne et de Budapest; dans ces capitales on remplit les wagons de voyageurs sans le moindre égard aux places existantes; il faudra donc partout maintenir le principe de ne pas admettre dans les wagons de tramways plus de voyageurs qu'il n'y a de sièges.

II.—Moyens de sauvetage.

Chaque administration des chemins de fer est obligée de rendre possible que les voyageurs et les employés blessés ou malades puissent être pansés, transportés et secourus sans aucun délai.

Il faut aussi prendre les mesures nécessaires pour le transport de ceux qui souffrent de maladies contagieuses et éviter les dangers auxquels les autres voyageurs sains pourraient être exposés.

Maintenant on opère le transport des malades contagieux dans des coupés séparés, soumis à la désinfection.

Je suis d'avis que ni la séparation, ni la désinfection ne sont suffisantes pour sauvegarder les voyageurs de l'infection.

Pour éviter ce grand danger, j'ai fait construire en 1881 une voiture spéciale pour le transport des malades et des blessés qui fut visitée dans tous ses détails à l'occasion de l'exposition générale d'hygiène de Berlin par les Professeurs Billroth, Langenbeck, et Esmarch, et reçut le grand diplome d'honneur.

Les principes dominants de la construction de cette voiture sont les suivants :—

(*a.*) Double usage des lits mobiles placés dans les wagons, comme civière et comme gîte du malade ; on peut enlever le lit avec la plus grande facilité.

(*b.*) Il est possible d'installer le malade ou le blessé dans son propre lit transporté dans le wagon.

(*c.*) La désinfection complète des lits transportables s'opère sans la moindre difficulté.

(*d.*) La voiture de sauvetage est pourvue de tous les instruments et objets de pansement nécessaires, de glace, d'eau chaude et froide, de médicaments ; dirigé au lieu d'accident, le wagon peut être utilisé même lorsque le nombre des blessés est grand.

Les chemins de fer de l'État hongrois emploient ces voitures pour le transport des malades et des blessés et il est dans l'intérêt de la santé des voyageurs que des voitures spéciales existent partout pour le transport des malades et des blessés. (La description et les plans du wagon sont joints, p. 128.)

Des civières et des boîtes de secours doivent être présentes à chaque station, et chaque train doit être muni d'un petit étui à pansement contenant aussi quelques médicaments nécessaires.

Il est inutile de placer de grandes boîtes de secours dans le train, car les objets contenus sont gâtés malgré la meilleure fermeture par l'ébranlement continuel.

Chaque station doit être pourvue d'un reservoir à glace.

Le personnel des chemins de fer doit recevoir des instructions suffisantes en tout ce qui concerne le sauvetage, et les premiers secours à donner aux blessés ou aux malades.

Les médecins des chemins de fer sont obligés de donner ces instructions au personnel et de surveiller continuellement le bon état de tous les appareils de sauvetage.

III.—Conditions hygiéniques du Service des chemins de fer.

Dans l'intérêt des voyageurs comme dans celui des employés le principe est à maintenir que le service se fasse sans danger pour la santé des employés et sans le surménage du personnel, par lequel la sûreté des voyageurs serait menacée au plus haut degré.

La longue durée continuelle du service devient la cause de maladies corporelles et même d'aliénations mentales.

Il faut donc que chaque administration de chemin de fer soit obligée d'avoir un nombre suffisant d'employés, de manière que leur santé ne soit pas compromise par le surménage qui peut aussi devenir fatal aux voyageurs.

C'est surtout le personnel du trafic et des trains qui ne doit pas être exposé aux conséquences funestes de la lassitude, car c'est la grande fatigue par laquelle une grande partie des accidents est causée.

Il faut sauvegarder le personnel contre les intempéries du temps et les pourvoir des vêtements correspondants aux saisons ; tout vêtement qui empêche le libre mouvement est dangereux, et ce sont surtout les

longues pélisses ou redingotes qui sont devenues la cause de fâcheux accidents.

Les yeux doivent être gardés par des lunettes à verres foncés contre l'éclat des champs de neige.

Il est aussi nécessaire que chaque employé jouisse annuellement d'un congé de quinze jours.

IV.—Le Service de Santé.

Il faut employer pour le service de santé des médicins prêts à chaque moment à secourir les malades et les blessés du personnel et en cas d'accidents les voyageurs.

Les médecins ont aussi l'obligation de visiter les employés concernant leur aptitude pour le service, la mise en retraite, les cas de simulation, etc.; ils enseignent au personnel les éléments des premiers secours et ils rédigent la statistique médicale.

Les médecins des chemins de fer ne s'occupent donc pas exclusivement du traitement des malades, mais ils fonctionnent aussi comme les organes de contrôle des directions.

Il serait donc dans l'intérêt des administrations de donner à leurs médecins les mêmes avantages qu'aux autres employés.

Mais la plus grande partie des administrations ne suit point ce principe.

Le médecin des chemins de fer a une position indécise.

Il est regardé en véritable employé quand on l'oblige de rendre des services, mais dès qu'il est question de lui faire les avantages des employés comme bénéfice fixe, droit de retraite, etc., sa situation change et il appartient aux organes amovibles et privés des droits des employés.

Cette position éphémère des médecins des chemins de fer ne sert point à l'avantage du service de santé.

Il est donc dans l'intérêt non seulement des médecins, mais aussi dans celui du personnel, de donner aux médecins la même position qu'aux autres employés, avec le droit d'avancement et de retraite.

Le service médical est souvent rendu difficile par le manque des moyens de transport; il serait donc utile de pourvoir chaque médecin employé d'une draisine ou d'un vélocipède.

Il est aussi avantageux de mettre une petite pharmacie manuelle à la disposition des médecins, comme c'est introduit auprès des chemins de fer de l'État hongrois avec le meilleur succès.

La direction et le contrôle du service de santé exige un médecin expérimenté qui soit dans la même position que les chefs des autres services.

Conclusions.

I.—Il est nécessaire que les plans de construction des bâtiments et des voitures soient jugés au point de vue hygiénique par le chef de service de santé qui devra aussi prendre part à l'enquête d'exploitation.

II.—Il faut que la construction des voitures soit telle qu'elle n'empêche pas les voyageurs de se sauver en cas d'accidents; par conséquent: pas de couloirs latéraux étroits, mais des portes facilement accessibles et s'ouvrant sans difficulté.

III.—Les sièges des voitures doivent être également larges et commodes dans toutes les classes.

IV.—Il sera nécessaire de transformer et d'améliorer le chauffage et l'éclairage des voitures.

V.—Il ne sera pas permis de laisser entrer dans les voitures des tramways plus de voyageurs qu'il n'y a de sièges.

VI.—Il faut construire et mettre à la disposition du public des voitures spéciales pour le transport des malades et principalement de ceux qui sont atteints de maladies contagieuses.

VII.—Il faut que chaque station soit pourvue d'une boite à secours, d'un brancard et d'un réservoir à glace, et chaque train d'un petit étai à pansement.

VIII.—Il faudra éviter soigneusement le surménage du personnel et surtout des employés du trafic; par conséquent il faudra les nommer en nombre suffisant; il sera utile de donner à chaque employé pour la restauration de ses forces sur sa demande annuellement un congé de 15 jours.

IX.—Les affaires de santé doivent être dirigées par un médecin hygiéniste expérimenté en qualité de directeur de service.

X.—Les médecins des chemins de fer doivent jouir des droits des autres fonctionnaires, notamment du droit d'avancement et de retraite.

Si les directions des chemins de fer suivent ces principes proposés, elles auront tout fait pour le bien-être de leur personnel et des voyageurs.

Mais le voyageur doit aussi pourvoir aux exigences de sa santé et connaître les influences fâcheuses auxquelles il peut être exposé, surtout pendant la durée d'un long voyage.

Le voyage en chemin de fer est le plus sûr parmi tous les autres moyens de locomotion; selon les résultats d'une statistique rigoureuse des dernières dix années il y a eu dans la monarchie austro-hongroise et dans l'empire allemand un cas de mort sur 15 millions et un cas de blessure sur 4 millions de voyageurs en chemin de fer.

Le voyage comme tel est incontestablement utile à la santé si son mode et ses conditions correspondent à l'individualité du voyageur.

On a beaucoup parlé et écrit sur les maladies spéciales auxquelles les employés des chemins de fer et les voyageurs seraient exposés.

D'après l'expérience et les études de 32 années je suis en état d'affirmer que ces maladies spéciales, c'est-à-dire, causées par les voyages en chemin de fer, n'existent pas.

Il est incontestable que le surménage physique et intellectuel, le manque du sommeil, la position inusitée et incommode du corps peuvent devenir les causes des maladies des voyageurs, mais si les administrations suivent les principes établis en ce qui concerne les places des voitures et le travail des employés, et si les voyageurs ne commettent pas de fautes hygiéniques, on évitera facilement toute cause de maladie.

On ne peut nullement fixer en général les prescriptions valables sans aucune exception pour les voyageurs, car il y a grande différence entre le voyageur qui fait le voyage pour son plaisir et celui qui est

obligé de voyager; j'essayerai pourtant de donner aux voyageurs quelques conseils qui pourraient leur être utiles :—

1. Il ne faut pas voyager en état malade ou indisposé sans avoir consulté le médecin; il faudra agir de même si l'on devient malade pendant le voyage.

2. Le voyage pendant la nuit est à éviter autant que possible; la nuit est le temps naturel du repos et le sommeil dans les wagons n'est pas réparateur à cause de l'ébranlement continuel; si néanmoins on est forcé de voyager pendant la nuit, il sera utile de se servir des wagons-lits; en tout cas il faudra se débarrasser des vêtements et des corsages étroits, et remplacer les bottes ou souliers par des pantoufles commodes, ne serrant point les pieds.

3. Il ne faut pas voyager trop longtemps continuellement; 8–10 heures de voyage en train de vitesse suffisent; la plus longue durée est une cause de lassitude pour la plupart des voyageurs.

4. Pendant le voyage il faudra observer la plus grande tempérance en collations et boissons, si non, on sera exposé à de graves inconvénients.

Il sera aussi utile d'être en possession de quelques comestibles surtout dans les trains qui n'ont pas de wagons restaurants, car le temps destiné au dîner est en général très-court et rarement suffisant pour qu'il puisse être pris avec le confort désirable.

5. Le vêtement doit être léger et accommodé à la saison du voyage.

C'est une grande faute de ne pas se munir en hiver de vêtements chauds, croyant que les voitures sont assez chauffées; il est vrai que l'on a rarement besoin du manteau dans la voiture même, mais il est d'autant plus nécessaire en sortant, quand on est exposé à toutes les rigueurs de l'atmosphère.

Les dames devront se passer de longues robes pendant le voyage, car elles pourront devenir la cause d'accidents funestes, en empêchant le libre mouvement en entrant dans la voiture et aussi en sortant.

6. Si l'on voyage longtemps, 10–15 heures, il faut donner de temps en temps une position horizontale aux extrémités inférieures; si les pieds sont toujours pendants, il en résultera l'enflure œdème.

7. Il ne faut pas lire continuellement, surtout dans les trains de vitesse; la lecture devient très-nuisible aux yeux, si on ne leur donne pas du repos de 10–15 minutes; l'éclairage artificiel n'est convenable à la lecture que s'il est parfaitement suffisant; le crépuscule dominant dans la plupart des wagons gâte les yeux du liseur, et en général il ne faudra pas s'occuper de lecture si elle cause le moindre désagrément aux yeux.

Il faudra aussi préserver les yeux contre les étincelles à l'aide de lunettes simples et contre l'éblouissement causé par les neiges à l'aide de lunettes de teinte foncée.

8. Il faut bien se garder d'entrer dans un train ou de sortir d'un train qui est en mouvement même assez lent, car une secousse imprévue peut devenir facilement la cause de la mort de celui qui enfreint les règlements.

DESCRIPTION de la voiture d'ambulance des Chemins de fer R. de l'État hongrois.

Cette voiture, destinée au transport des malades et des blessés, est posée sur un châssis entièrement en fer, à deux essieux, distants entre eux de 6 mètres. Les dimensions de la caisse et les autres parties extérieures sont analogues à celles des anciennes voitures à intercommunication.

Cette voiture est munie à l'une de ses extrémités seulement et des deux côtés de la voiture, de marchepieds donnant accès à une plateforme fermée; le soufflet d'intercommunication de ce côté peut être adapté à la paroi frontale de cette plateforme, tandis qu'à l'autre extrémité de la voiture le soufflet d'intercommunication est adapté directement à la portière de la paroi frontale de la caisse même.

Dimensions principales de la voiture :—

	m.
Longueur totale mesurée entre l'aplomb de buttoirs tampons - - - -	11,060
Longueur de la plateforme - - -	0,750
Largeur de la plateforme - -	1,910
Longueur de la caisse - - - -	9,080
Largeur de la caisse - - -	3,120
Hauteur de la caisse - - - -	2,465

Les installations intérieures de la voiture sont les suivantes :

De la plateforme on pénètre, par une portière à deux battants, dans une salle partagée dans sa longueur en 4 compartiments dont 3 de 2^m, 100 et un de 0^m, 660 de largeur, séparés entre eux par des parois à hauteur d'appui.

Dans chacun des 3 premiers compartiments sont placés à droite et à gauche, près des fenêtres, deux lits-civières du système Eckermann, soit en tout 6 lits pour les malades et les blessés.

Les compartiments peuvent être clôturés par des rideaux fixés au-dessus des parois de séparation.

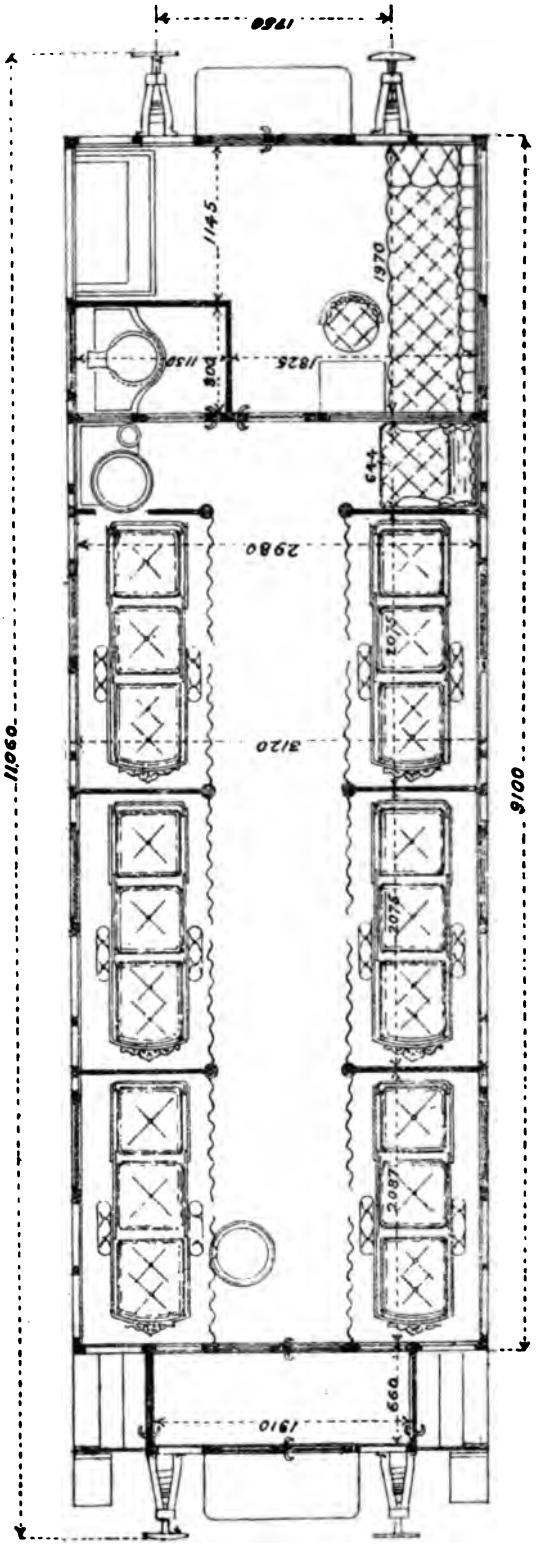
Dans le dernier compartiment plus étroit se trouve à gauche un fourneau, et à droite un siège rembourré pour le garde-malade.

Aux parois latérales de la voiture sont fixés au-dessus des fenêtres des portebagages et une glacière en toile est installée en contre-bas du plancher de la salle.

Cette salle communique par une porte à un battant avec le compartiment du médecin de service; dans ce compartiment, d'une longueur de 1^m, 970 se trouvent à droite un divan-lit, dont le tiroir contient les bandages et autres objets de pansement, à gauche une armoire pour la pharmacie et les instruments de chirurgie; enfin une table mobile et un fauteuil rembourré.

A gauche du compartiment du médecin se trouve un cabinet de toilette avec water-closet dont le réservoir-à-eau est fixé au plafond de la voiture; l'on entre dans ce cabinet par la salle des malades.

Chaque paroi latérale de la voiture a 4 fenêtres, dont 3 de chaque côté pour la salle des malades, la quatrième à gauche pour le compartiment du médecin, et la quatrième à droite pour le cabinet de toilette; les portières des parois frontales sont aussi vitrées.



WEIGHT, 11.585 KG. 6 BERTHS.

La salle est éclairée la nuit par 3 lampes à huile du type règlementaire, fixées au plafond, et le compartiment du médecin par deux lampes à huile fixées l'une au plafond et l' autre à la paroi.

La ventilation se fait par des glissières à jour placées au-dessus des fenêtres et par deux ventilateurs-aspirateurs appliqués au plafond.

The Revolving Purifier for Treatment of Potable Waters by means of Metallic Iron.

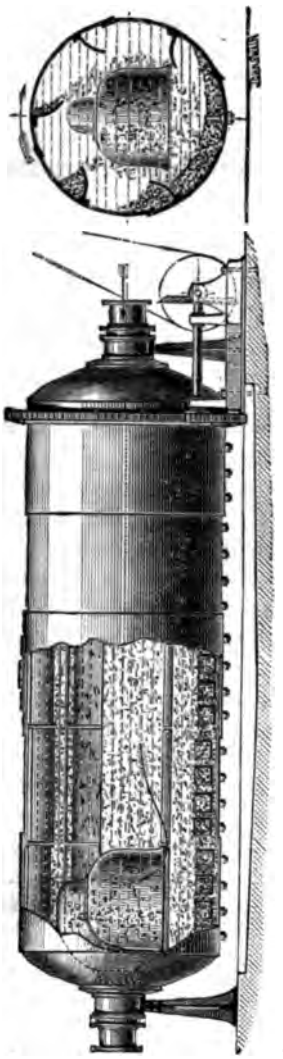
BY

WILLIAM ANDERSON, D.C.L., F.R.S., M.I.C.E.

Since the revolving purifier for the treatment of potable water is no novelty, but has been at work on a large scale at various places for some six or seven years, it is not proposed to enter into any detailed description of the apparatus, or of its mode of working. For the information, however, of those who are not acquainted with the purifier, a short account is necessary. The apparatus consists of a cylinder, supported horizontally on two hollow trunnions, of which one serves for the entrance and the other for the exit of the water. The cylinder contains a certain quantity of metallic iron, in the form either of cast-iron borings, or, preferably, of scrap iron, such as punchings from boiler plates. The cylinder is kept in continuous but slow rotation by any suitable means, the iron being continually lifted up and showered down through the passing water by a series of shelves or scoops fixed inside the shell of the cylinder. By this means the water, as it flows through, is brought thoroughly into contact with the charge of iron, which, in addition, by its constant motion and rubbing against itself and the sides of the cylinder, is kept always clean and active. Simple contrivances for preventing the iron from being carried out of the cylinder or piled up at the outlet end, and for distributing the current of water over the whole area of the cylinder are also furnished, but need not be described.

The water as it leaves the cylinder appears to have undergone only one change of any importance, viz., a quantity of iron, ranging from one-tenth to one-fifth of a grain to the gallon has been taken up, and to get rid of this the water has to be aerated either by blowing in air, or by merely allowing it to flow along a shallow open trough; in both cases repose in a settling reservoir is necessary. After a few hours—from two to six in most cases, much less in some—the greater part of the iron will have subsided to the bottom of the settling tank, usually as loose flakes of iron peroxide associated with organic matter and other

impurities, and the water is then ready for filtration. In most cases a rapid passage through a shallow layer of sand is all that is required to separate the iron, which remains as a fine layer on the surface of the sand, while the water issues from the filter free from iron, greatly ameliorated as regards organic matter, and practically deprived of microbes.



The revolving purifier was invented by the author in 1884–5, to meet the difficulties which arose in the working of the "spongy-iron" filters at the Antwerp waterworks. These filters which consisted of a mixture of "spongy iron" and gravel, choked up gradually and became almost inactive, after working for three years very satisfactorily as regards the purification of the water. They were replaced by the revolving purifiers, which have been in operation there ever since with most satisfactory results. It is not necessary in this paper to repeat the numerous details of working results at Antwerp, as they have already been made public, but it is proposed to lay before the members of the Congress results obtained on the practical scale at other places during the past year.

Boulogne-sur-Seine.—A purifier with a 6-inch inlet pipe capable of dealing with 200,000 gallons of water daily, was erected last summer at the pumping station of the Compagnie Générale des Eaux at Boulogne-sur-Seine. It was furnished complete with filter beds, and having worked during the autumn of 1890 remains still in operation. Very exhaustive trials and analyses were made by the Compagnie Générale des Eaux to test the system, principally with respect to the removal of bacteria, and of organic matter as estimated by permanganate of potash. The results obtained are thoroughly satisfactory, especially as regards bacteria. The numbers determined in the autumn of 1890 are interesting, as illustrating the experimental stage of the working of the plant. During the first two periods of working, for which the average percentage reduction of organic matter is given, the charge of iron in the revolving purifier, originally rather deficient, was further reduced by solution; during the third period the charge was made up to its full weight, and kept constant by periodical additions of iron.

Average percentage reductions of organic matter estimated by permanganate of potash.

1st Period.	2nd Period.	3rd Period.
42 per cent.	40 per cent.	66 per cent.

The number of microbes was on the average reduced to 50 per cubic centimetre in all three periods.

The experiments with this purifier were stopped about Christmas last, and the Compagnie Générale des Eaux ordered plant for dealing with the entire supply from these waterworks; but to obtain additional evidence of the efficacy of the system, the 6-inch machine was started again in May of this year, and the first few sets of analyses gave the results represented in the Table, which show a very constant and high co-efficient of purification in very varying conditions of the river, the lowest improvement, 36 per cent., occurring the day after a heavy rainstorm which washed some rubbish into the filters.

Date.	Organic Matter (expressed in milligrams of Oxygen per litre).			Microbes.*	
	Seine.	Purified.	Improvement °/₀.	Seine.	Purified.
May 20	3·44	1·14	67	830	85
„ 22	2·24	1·60	36	2,500	72
„ 25	3·04	0·96	69	7,200	65
„ 27	3·60	1·04	71	3,840	33
„ 29	3·12	1·04	67	6,420	48
June 1	3·52	0·88	75	—	—
„ 3	4·72	0·88	82	4,500	36
„ 5	4·88	1·04	79	1,600	50
„ 8	3·60	1·20	67	5,800	22
„ 10	2·88	1·20	59	L.	24
„ 12	3·68	1·28	65	L.	10
„ 15	3·52	1·04	71	—	—
„ 19	3·68	1·44	61	—	—
„ 22	2·08	1·28	39	L.	35
„ 24	2·24	1·20	47	L.	L.
„ 26	2·96	1·12	62	L.	8
July 3	3·12	1·20	62	—	—
„ 6	3·76	1·28	66	—	—
General Means	—	—	63	4,086	40

The analyses show that the satisfactory results obtained during the thir period in the autumn can be considered as normal under any circumstances, and that the Compagnie Générale des Eaux may look forward with confidence to supplying a good potable water from this pumping station as soon as the permanent plant has been set to work.

It has been asserted by critics of the author's system that the quantity of free oxygen dissolved in water is seriously diminished by treatment

* The number of microbes here given must be considered as no more than a rough estimate, because the colonies were observed for only six days instead of for fifteen—the usual period of experiment. The principal object of the numerous trials and analyses made was to ascertain the reduction of organic matter.

with iron—it has even been boldly stated that the water is entirely and permanently deprived of its dissolved oxygen—and that in consequence the purified water has a flat and vapid taste. As a matter of fact, seeing that a thorough aeration of the water on leaving the purifier is essential for the complete conversion of the ferrous salts into the ferric form, and is always provided for, the free oxygen, even if it were diminished in the purifier, is immediately replaced, so that the quantity contained undergoes no very great diminution.

M. Regnard, chemist to the Compagnie Générale des Eaux, reports that at Boulogne-sur-Seine the diminution of dissolved oxygen is very trifling. It some cases it has even been found that the quantity is increased after treatment.

In order to show that the purifier system is really superior to simple sand filtration, careful comparisons of the relative efficiency of the two systems have been made in many places, sometimes using the same filters with and without the purifiers, sometimes using precisely similar filters simultaneously under identical conditions. The figures already quoted for Boulogne-sur-Seine are of themselves a sufficient proof of the efficacy of the purifier system, the percentage reduction of about 40 per cent. when the machine was working under not quite satisfactory conditions, rising to 60 per cent. when these conditions were improved. To supplement this, the following figures may be quoted:—

At Agra a machine was erected capable of dealing with 50,000 gallons a day. Mr. A. J. Hughes, M.Inst.C.E., Supervising Engineer, Municipal Works, N.W.P. and Oudh, India, reported that the reduction of organic matter by simple sand filtration, at a speed of 24 gallons per square foot (per 24 hours), was 57 per cent., and that the reduction of organic matter by the revolving purifier system, filtering at a speed of 35 gallons, was 64 per cent., *i.e.*, 12 per cent. better results at 50 per cent. higher speed of filtration. In consequence of this experiment, purifiers have been erected to purify the whole supply for Agra. They have been at work now about six months, and are giving most splendid results, but unfortunately the figures have not arrived in time for insertion in this paper. Mr. Hughes has, however, stated that the albumenoid ammonia is reduced from 0·13 to 0·02 parts per million.

At Monte Video are three machines capable of treating 1,250,000 gallons daily. The reduction of organic matter by simple sand filtration, deduced from the average of fourteen analyses extending over a month, is 30 per cent.; reduction of organic matter by revolving purifier system, average of 13 analyses, extending over the same period, 47 per cent.

In these cases the same filters were used with and without the purifiers, which, if anything, favoured the simple sand filtration.

At Molesey Lock there is an experiment on a practical scale, consisting of a machine capable of dealing with about 6,000 gallons daily. It is at work purifying Thames water on the Lock Island. There are two similar filters, one reserved for simple sand filtration, the other for

filtration after treatment with iron in the purifier. Average results obtained during the autumn of 1890:—

—	Thames.	Filtered.	Purified and Filtered.
Mean albumenoid ammonia (parts per million)	0·087	0·049	0·039
Mean total organic matter (Kubel & Tiemann process; gram. per litre) - - -	0·047	0·037	0·031
Mean reduction per cent. albumenoid ammonia	—	44 per cent.	55 per cent.
" " total organic matter-	—	20 "	33 "
Mean total reduction - - -	—	32 "	44 "

The system was worked under different conditions, some of which gave better purifications than others, but all results for the autumn of 1890 are included in the above means.

In conclusion, it may be stated again that the results quoted in the paper and the figures given have not been obtained by small laboratory experiments, but from installations, some of a very large size, working continuously under practical conditions; and, with the exception of Agra, all have been obtained during the last twelve months, and may be regarded as corroborative evidence on the points demonstrated by previous analyses and experiments at Antwerp and elsewhere. The quotation of favourable isolated cases has been avoided, and the average results derived from series of experiments have been given wherever such existed.

The Purification of Water by Rapid Filtration.

BY

PHILIP S. WALES, Medical Director, U.S. Navy.

The purification of water is a subject of great interest and importance, as well from a hygienic as from an industrial point of view. As the varied sources from which water is drawn for domestic use are liable, from either natural or artificial causes, to pollution deleterious to health and favourable to the dissemination of disease, its purity becomes a question of paramount importance.

The simple process of purification by boiling the water alone or with some astringent substance has been in vogue among the Chinese and other Orientals from a remote period. Distillation is also often used on a small scale, especially on board ship, and notably on the coast of Peru, where the water is impregnated with sodium nitrate. Filtration is also a common method employed in the household by the aid of the numerous forms of domestic filters, made of various porous substances, sand, stone, charcoal, sponge, &c.

The purification of large quantities of water for domestic and industrial purposes can only be effected by large filter beds or by

specially devised machines, and it is the intention of this paper to dwell alone upon the latter method, the characteristic feature of which is to cause the water to pass rapidly through the filter bed under pressure. This system is the one making the most rapid strides in the United States, and is now the subject of investigation at the Museum of Hygiene, Washington, D.C.

The filtering machines are constructed of iron cylinders which are placed upright in the smaller sizes and horizontally in the larger.

The dimensions of the cylinders vary in diameter and length, according to the amount of work they are intended to accomplish, that is to say, according to the quantity of water required and the amount of foreign matter in it.

It is found best in practice to restrict the diameter within 10 feet, as the difficulty in washing increases rapidly with the area of the sand bed. The length ranges up to 25 feet. The pipes connect with the cylinders in such a way that the water is let in upon the sand, through which it filters to the outlet.

After the filter bed becomes embarrassed with the accumulated foreign matter, the current of water is by special contrivance reversed, so that it is passed from below upwards and washes out the impurities held in the sand, which are mostly confined to the surface, or at most to the upper two or three inches, of the filter bed. The "wash" water flows, at the end of the operation, very nearly as pure as the filtered water itself.

This is the general principle involved in the construction of the filtering machines. In some of them the cleansing is greatly facilitated by a stirrer or agitator mounted in the axis of the cylinder.

The time required for cleansing a filter will depend upon the condition of the water: if very muddy, or at its worst, as after a rain, about one hour; in ordinary conditions, half that time.

The cylinders are sometimes connected with pipes in such a way that any one of a system of cylinders may be washed with filtered water flowing from its nearest neighbour, or from one further removed in the line.

There are two principle types under which these machines may be classed. In the first, nothing but sand, or sand and charcoal is used as a filtering material; in the second, besides a filtering bed of these materials, the water is treated with alum, or sulphate of aluminium in definite doses, by a special contrivance before it reaches the bed. When the sand is alone employed, water, carrying heavy proportions of fine silt or suspended organic matter, is not entirely clarified as it is when this proportion is smaller. In such cases the alum gives most excellent results by massing the fine particles into such magnitudes that they are obstructed in the interstices of the sand.

If the alum is properly dosed, most of it will be caught in the filter bed; but if, on the other hand, an excess is introduced into the water, the amount in excess in solution will pass through the filter undecomposed, and the water will be correspondingly impregnated.

As this enables the filtration to be done more thoroughly, the filter necessarily becomes sooner clogged, and needs more frequent washing.

An idea of the amount of work which these filters may be called upon to perform may be conveyed by considering that some of the muddy, rapid rivers of the western section of the United States may, under the most unfavourable circumstances, carry as much as an ounce of fine mud to the gallon mixed with a variety of vegetable organisms.

The clarification of such water, if taken direct from the river, would embarrass the filter too much for successful rapid filtration; indeed, water containing a quarter of an ounce of foreign matter to the gallon, is a severe test for a filter.

In the first example, a filter discharging 250 gals. per minute would be charged with 15½ lbs. of solid matter in the same time; so that the thickness of the "blanket" of mud on the filter surface would soon arrest the flow of water.

In the experiments carried on at the Museum of Hygiene, it was found that it is the "blanket," or sedimentary layer which first forms on the top of the sand, which diminishes the flow of water long before the bed is penetrated to any extent. This phenomenon was carefully studied with the aid of a glass model.

It sometimes occurred in the small machines of the capacity of 10 gals. per minute, stopped by this surface deposit, that the flow was renewed to its full capacity by jarring the bed by a sharp quick blow upon the cylinder which dislodged this surface stratum.

If the water is heavily charged with solid matter it will be necessary, for efficient results, to get rid of the larger portion by sedimentation before passing it into the filter.

Alum greatly assists in clarifying heavily charged water. Now, as to the quantity of alum needed to clear up the water, it was shown that a half grain to the gallon will, on the average, answer for this purpose.

During the year 1890 there was used at Atlanta, Ga., waterworks 92,390 lbs. of alum, equal to 532,166,400 grains; $253\frac{12}{100}$ lbs. per day, equal to 1,457,971 grains; 617 grains of alum to 1,000 gals., or $\frac{617}{1000}$ grains per gallon.

In rapid filtration one square foot of filtering surface to three gallons per minute is usually allowed. A filter may be instanced with two cylinders, each five feet in diameter and 12 feet long with a stirring shaft for agitating the sand. Each shell has a filtering capacity of 259,200 per diem. The pipes in a system of such cylinders are so connected that the washing can be done with filtered water, and any one cylinder may be washed by any other. In other types of filters the washing is done with unfiltered water.

The sand is kept from washing out of the cylinders by various devices. In the "Loomis" by a simple perforated plate; in the "Duplex" by an ingeniously constructed perforated plate, into the perforations of which pins move, both to hold back the sand and to prevent clogging; in the "Hyatt," by shot or wires; and in the "Bowden," by perforated nozzles. All of these devices are found to work efficiently.

The space occupied by filters constructed upon the principle of those in question would, of course, vary with their capacity. On an average, a plant capable of filtering 1,000,000 gals. per diem, would occupy an area of about 25 feet by 30 feet, and 16 feet vertically. The cost of such a plant is between 8,000 dollars and 10,000 dollars. The expense of maintenance depends considerably upon the solid matter contained in the water. According to the report of the water commissioners of Atlanta, Ga., for the year 1889, the annual cost of maintenance of the filter plant (capacity 3,000,000 gals. per day), was 2,093·39 dollars.

This system of rapid filtration is successfully pursued at many places in the United States, among others at—

Oakland, Cal.,	capacity for 24 hours	-	4,000,000	gallons.
Atlanta, Ga.	„ „ -	-	3,000,000	„
Long-Branch, N.Y.	„ „ -	-	2,000,000	„
Ottumwa, Iowa	„ „ -	-	1,500,000	„
Athol, Mass.	„ „	-	1,000,000	„

Indeed there is no limit to the quantity of water that can be filtered by these machines; plans and propositions having been submitted to the City of Allegheny, Pa., for a filter plant with a capacity of 30,000,000 gals. per day.

In many industrial pursuits the water at hand is unfit for the manufacture of certain special products, and has, therefore, to be improved and adapted to the purpose by filtration.

In sugar refining the water is often so impure that it requires filtration to adapt it to this purpose.

At the Museum of Hygiene at Washington, D.C., four of the best types of house filtering-machines have been used for experimental purposes, the Duplex, Loomis, Hyatt, and Bowden. The Duplex filter consists of three cylinders, two charged with sand, the third with charcoal. The area of filtering surface is 1½ square feet, and the depth of the bed 2 feet 5 inches. The flow is rated at five gallons per minute.

After running for a time it becomes necessary to cleanse the filter; a valve is moved to either the right or left, by which motion one or the other of two pipes will be in communication with a pipe connected with the sewer for conveying away the impurities from the sand cylinders during the process of washing. This pipe, before entering the sewer, has inserted in it an ordinary ball trap with a glass cup, which exhibits the condition of the water coming from the filter during the operation of cleansing, and admits of determining the moment when the filter is sufficiently cleansed.

After the water has been running this way for a few minutes, the sand will become loosened in the cylinder, and a shaft with radial arms attached can then readily be turned for the purpose of thoroughly stirring up the sand and removing any adhering particles of dirt to be carried out with the cleansing water. By returning the valves to their original position the process of filtration will be continued.

If at any time it is desired to aërate the charcoal by a somewhat similar arrangement, the water can be removed from the charcoal and air will take its place, when the coal, having become sufficiently aërated, the filtering process can be continued as before.

Aëration can be effected, if desired, during the time the sand is being washed in the sand cylinders. If for any reason it be found necessary to take out the charcoal, it can be readily done by simply removing the bonnet from the cylinder, and scooping the charcoal out, as it is not packed but lies loosely in the cylinder.

When it is desirable to use alum the slightest trace of it is introduced into the water as it passes in.

The "Loomis" and "Hyatt" house filters are single cylinder machines.

An alum tank can be connected with the main inlet pipe at a convenient point, to dose the water as required; a small valve at the top of the alum tank controlling the alum supply.

The "Bowden" filter is a doubled-chambered cylinder, one above the other, filled with sand, so arranged that the filtered water from one can be used to wash out the other; and, after washing, both chambers are used for filtration. An alum chamber is attached which can be used when required.

The question will now naturally be asked, what effect has filtration on the purification of water from a chemical and biological standpoint?

In this paper we cannot discuss it at length (the final report of our investigations will do this), so we purposely omit all tabulated records, and give briefly some of the results we have obtained, which are of positive value. The albumenoid ammonia is reduced on an average by about 69¼ per cent.; this is the average of the four filters, and shows that filtration has a marked effect in removing organic matter.

The free ammonia is frequently increased; this of course, is readily understood by the breaking up of the albumenoid ammonia. When ammonium alum is used as a coagulant, this is markedly the case, and should be borne in mind when estimating the value of a filter.

The nitrites and nitrates are occasionally reduced, and in some cases increased, but in rapid filtration an increase would not be expected, as very little time is allowed for oxidation to take place in the organic matter. The chlorine is not appreciably effected, but the amount in the water we have been working on is so small (1·7) that more extended investigations are required to determine the question.

The hardness is reduced about 1 per cent., but our observations were made on the Potomac water, which is very soft (67 parts per million). With waters of a higher degree of hardness, filtration might make a greater reduction. The suspended matter is reduced 50 per cent.; the Potomac, when turbid, carries a large amount of fine particles of silicious matter which (without the use of a coagulant) even the finest filter paper fails to remove; only asbestos finely packed will clear it, and then the filtration is too slow for any practical use.

The matter in solution is slightly reduced, the amount is insignificant, but is all that can be expected. The non-coagulated alum used in the filters passes through unchanged (·42 grains per gal. was recovered from these filters, or 7·25 parts per million).

The filters remove 98 per cent. of the micro-organisms, as was found by direct experiments in plate culture. It is not expected that any filter can be germ-proof. Spores readily passed through the filtering material.

Ueber die Wirkung der Electricität auf die suspendirten und gelösten Stoffe der Abwässer.

VON

Dr. Claudio Fermi, aus dem hygienischen Institut in München.

Angeregt durch das von William Webster angegebene Verfahren, mittelst der Electricität Abwässer zu reinigen, stellte ich eine Reihe von Versuchen über die Wirkung des electrischen Stromes auf die in den Abwässern suspendirten und gelösten Stoffe, sowie auf die darin vorkommenden Pilze in dem unter Leitung von Prof. Emmerich stehenden bacteriologischen Laboratorium des hygienischen Instituts in München an.

Ich setzte mir folgenden Plan für die Versuche fest:—

1. Durch Vorversuche einigermassen die Art der Electroden, die Stromstärke und die Dauer der Einwirkung der letzteren zu bestimmen, die geeignet ist, um eine gewisse Menge Wassers zu reinigen.

2. Einwirkung des electrischen Stromes auf das Abwasser, verglichen mit der des Kalkes (1 %).

3. Einwirkung des electrischen Stromes auf die in den Abwässern gelösten Stoffe allein.

4. Einwirkung des electrischen Stromes auf verschiedene im Wasser lösliche Stoffe, wie Oxalsäure, Weinsäure, Rohr- und Traubenzucker, NH_3, Harnstoff, Salpetersäure etc.

Die Electrisirung der Flüssigkeiten wurde in der electrotechnischen Versuchsstation in München unter Leitung des Herrn Privatdocenten Dr. C. L. Weber ausgeführt.

Die Versuche wurden stets mit je 1 Liter Flüssigkeit ausgeführt.

Den electrischen Strom lieferte eine Dynamomaschine. resp, Accumulatoren; er wurde stets genau gemessen und durch einen Widerstandsregulator beständig auf constanter Stärke erhalten.

Die Stromstärke variirte von 0·5–2 Ampère. Die Entfernung der Electroden von einander betrug 5 cm.

Bei den Versuchen, auf deren Resultat es in erster Linie ankam, wurden als Electroden Eisenplatten von 80 qcm. Oberfläche angewandt.

Kurz zusammengefasst waren die Ergebnisse etwa folgende :—

1. Bei Anwendung eiserner Platten von 80 qcm. Oberfläche als Electroden ist die Wirkung des electrischen Stromes auf das Wasser viel stärker als bei Anwendung solcher von 40–20 qcm., oder solcher aus Kupfer, Kohle oder Platin.

2. Je stärker der Strom, je grösser die Oberfläche der Electroden ist, und je länger die Electrisirung protrahirt wird, desto schneller und vollkommener geht im Allgemeinen die Reinigung des Wassers vor sich. Die organischen Substanzen in 1 Liter Wasser konnten durch einstündige Einwirkung eines electrischen Stromes von 0·5–1 Ampère und bei Anwendung flacher eiserner Electroden von 80 qcm. Oberfläche und 5 cm. Abstand von einander bis zu $\frac{1}{3}$ reducirt werden. Die Zahl der Pilze wurde dabei um das 50–100fache verringert.

Immerhin war die reinigende Wirkung eines Stromes von 0·42 Ampère auf 1 Liter Kanalwasser, eine Stunde lang fortgesetzt, geringer als bei Zusatz von 1 °/₀ Kalk. Durch Kalkzusatz wurde das Wasser vollkommen steril und blieb es auch nach 48 Stunden, während im electrisirten Wasser nach dieser Zeit die Anzahl der Pilze wieder um das fünffache zugenommen hatte.

3. Die stärkere Wirkung des electrischen Stromes bei Anwendung eiserner Electroden mit breiterer Oberfläche kommt nicht durch eine grössere ausgeschiedene Eisenmenge zu Stande, indem im Allgemeinen bei grösseren Electroden weniger Eisen ausgeschieden wird als bei kleineren, da im ersteren Falle die Electrolyse regelmässiger verläuft und augenscheinlich an der negativen Electrode ebenso viel Eisen niedergeschlagen wird, als sich an der positiven löst, während im letzten Falle bei grösserer Stromdichte kein cohärenter Niederschlag an der negativen Electrode entsteht; die an der positiven ausgeschiedene Eisenmenge verbleibt daher grösstenteils in der Flüssigkeit.

4. Schwache Ströme, wie z. B. von 0·063 Ampère, gaben auch bei längerer Einwirkung (bis zu 5 Stunden) keine befriedigenden Resultate.

5. Im Gegensatz zu den meisten bekannten chemischen Reinigungsmitteln werden durch den electrischen Strom auch einige oxydable organische Stoffe in ihrer Menge reducirt. Die gelösten Stoffe des Kanalwassers konnten bis zur Hälfte reducirt werden.

6. Oxalsäure in 0·2 °/₀₀ Concentration wurde durch einstündige Einwirkung eines Stromes = 0·55 Ampère bis zu $\frac{2}{3}$ oxydirt.

7. Weinsäure, ebenfalls in 0·2 °/₀₀ Concentration und ohne Anwesenheit von Chloriden wurde durch einstündige Einwirkung eines Stromes = 0·60 Ampère bis zum 30fachen oxydirt.

Nahm man dieselbe Säure in stärkerer Concentration, z. B. 10 °/₀₀, so entstand auch bei Anwesenheit von NaCl und bei Anwendung stärkerer Ströme (2 Ampère) keine Oxydation. Die Säure wurde nur teilweise neutralisirt.

8. Rohr- und Traubenzucker in schwächeren wie in stärkeren Lösungen, mit und ohne Zusatz von Chloriden, wurden auch bei Anwendung sehr starker Ströme (2 Ampère) nicht reducirt. Im Gegenteil wurde hie und da bei der Titrirung mittels der Chamäleon- oder der Fehling'schen Lösung eine geringe Zunahme beobachtet.

9. Durch Kochen der filtrirten Abwässer mit Kalk nahmen die gelösten Stoffe (durch Spaltungen) an Menge zu.

10. Der Zusatz von NaCl begünstigte durch Entwicklung von freiem Chlor wesentlich die Oxydation einiger organischer Substanzen und die Zerstörung der Pilze.

11. Auf eine Ammoniumchloridlösung (0·0786 °/₀₀) wurde durch die einstündige Einwirkung eines Stromes = 1·1 Ampère keine Wirkung des electrischen Stromes constatirt.

12. Auch auf eine 2 °/₀₀ige Harnstofflösung war keine Einwirkung nachweisbar.

13. Die salpetrige Säure wurde oxydirt. In einer 0·0406 °/₀₀ salpetrigsauren Kalilösung war nach der einstündigen Electrisirung bei Anwendung eines Stromes = 1·2 Ampère keine salpetrige Säure mehr nachzuweisen, wohl aber Ammoniak. Von Salpetersäure war keine Spur zu finden.

14. Das Wesen der Wirkung ist ein physikalischer und ein chemischer Process. Durch die Fällung des Eisenoxydul hydrats nemlich und durch die Gasentwicklung werden die suspendirten Stoffe teils niedergeschlagen, teils an der Oberfläche der Flüssigkeit angesammelt, und es entstehen durch die Wirkung des electrischen Stromes selbst mannigfaltige Zersetzungen, bei welchen NH_3, Sauerstoff und Chlor gebildet werden. Durch den Sauerstoff und das Chlor können leicht oxydable organische Stoffe oxydirt werden.

15. Die Pilze werden durch die Einwirkung des electrischen Stromes wie alle anderen suspendirten Stoffe niedergeschlagen. Jedoch könnte bei Gegenwart von freiem Chlor auch eine Zerstörung derselben zu Stande kommen.

The Water Supply of Maritime Towns.

BY

EDWARD F. WILLOUGHBY, M.D. (LOND.).

The general depression of the water level throughout the basin of the lower Thames which, as seen in deep wells, has amounted to not less than 20 feet in the last 20 years, affords incontestable evidence of the fact that the water companies of London and the neighbouring towns have long been abstracting from the land a volume of water greater than that portion of the rainfall which, percolating to the deeper beds, serves to maintain the natural underground storage; that we are, in fact, drawing on our capital, which is visibly shrinking, and that this annual excess of expenditure over receipts must, sooner or later, end in bankruptcy; in other words, that the lowering of the ground-water, and the drying up of the streams, already reduced in number and volume, will,

if continued long enough, convert what are as yet fertile arable and pasture lands into little better than a desert; while schemes for satisfying the increasing demands of the metropolis, or for obtaining a purer supply than that provided by the Thames and Lee, which involve the extension of deep borings into the underlying eocene or cretaceous beds, or intercepting the tributaries of the Thames nearer to their origins, can only have the effect of hastening the catastrophe, and stand self-condemned.

These considerations have suggested to me an essential difference in the conditions of maritime and of inland towns, which, though it has, so far as I can learn, escaped the attention of engineers, has an important bearing on the questions alike of water supply and of sewage disposal. By maritime towns I mean not only those immediately on the sea coast or on estuaries, as Brighton, Plymouth, Liverpool, Hull, and Glasgow, but all such as are situated on tidal reaches, as London and Bristol, or—like Paris and Manchester—on points in the course of rivers where they have ceased to act as irrigators of the valleys through which they flow.

In the case of an inland town every drop of water withdrawn from the land, whether before its absorption by means of catchment reservoirs and the impounding of upland streams, or afterwards by pumping from wells and rivers, is, save under exceptional circumstances, sooner or later returned, directly or indirectly, to the land, feeding the rivers that, in their course to the sea, water the intervening country. I do not ignore the question of the pollution of rivers, for I maintain that sewage should everywhere be treated in the only satisfactory manner, viz., by intermittent filtration through the soil, when the effluent does not appreciably deteriorate the river into which it is discharged, while the full utilization of the fertilizing matters of the sewage, as well as of the water itself, is achieved. Indeed, if, as at Berlin and Königsberg, the sewage is distributed over a wide extent of poor, light soil, and reaches the river or sea only after having undergone the most complete utilization and purification possible, the benefit to the land from an economic, and to the population from a hygienic standpoint is positive and great. All so-called chemical methods of purification are delusions; they may render the effluent inoffensive for the moment, but it undergoes subsequent putrefaction, and is, under all circumstances, wasted.

But maritime towns and those on the tidal and lower reaches of rivers are in a very different position. They pour, directly or indirectly, into the sea the whole of the water they have withdrawn from the land, which is so much the poorer for the loss. If their population be small, and its demands such as not to involve any appreciable lowering of the subsoil water or drying up of the streams, no harm may result, though, even then, the treatment of the sewage by filtration is, in all cases, desirable.

But when the population amounts to a hundred thousand, I would lay it down as a law that any scheme for a water supply to be derived from borings in the surrounding country or from the upper reaches of the

rivers running through it, or from springs, lakes, or other sources from which these streams are fed, should be deemed—as it will, sooner or later, be found to be—an economic blunder, an offence against the public good.

Such towns should be compelled to seek their supplies from one or other of two groups of sources, viz., uncultivated mountainous or moorland districts, where the rainfall is greatly in excess of the local needs, and where such abstraction will not cause injury to the agricultural or other interests of the valleys below; or, secondly, from subsoil waters naturally running to waste.

For examples of the former I may refer to Glasgow, Liverpool, and Manchester, which draw their supplies from Loch Katrine, from the Vyrnwy Lake, and from Thirlmere, as well as to Plymouth, Bristol, and Edinburgh, which collect the surface water or impound the streams on the Dartmoor, Mendip, and Pentland hills.

Of the second I cannot give more than one example, but it is in the highest degree interesting and instructive. This is Brighton, which derives its supply from borings and adits driven in the chalk. Since waters from this formation are usually held in high esteem, it will be well to consider the different circumstances of London and Brighton from a geological point of view.

The chalk in this country forms a belt of irregular width and varying contour, stretching from Dorchester to Cromer and the Norfolk coast. From the lofty plateau of Salisbury Plain extend two ranges of hills, known as the South and North Downs, the former ending abruptly in Beechy Head and the latter at Dover and the Kentish Foreland. The beds of which these two ranges are composed are strongly anticlinal. Those of the North Downs are identical with those forming the main belt from Wiltshire to Norfolk, being, in fact, continuous with them beneath the tertiary beds of the London Basin and Valley of the Thames, including the county of Essex. So much of the rainfall as does not go direct to feed the affluents on either side of the Thames is stored up, at least where the adjacent gault clay is not interrupted, in the lower beds, forming a vast but far from an inexhaustible reservoir. The difference between the rainfall and the loss by surface drainage and evaporation does not, however, represent the available storage, for the evidence afforded by the unsuccessful borings at Kentish Town and Richmond shows that the great underground reservoir is by no means perfect, the impervious bottom being wanting in various places, and the ultimate destination of the water at these points unknown. On the other hand, between the North and the South Downs, those of Epsom and of Brighton, the chalk has been removed by denudation following the upheaval of the underlying Wealden, which here comes to the surface, forming what is geologically a valley, though geographically elevated to a water-shed parting the series of streams, running northwards to the Thames and southwards to the Channel, formed by the surface drainage of the heavy clays of the western and larger half of this area. The greater part

of the rainfall and storm-waters, owing to the impervious nature of the soil, instead of being absorbed find their way beneath the chalk on either side blending with the rainfall which on the chalk itself is almost wholly absorbed. Northward this supply is added to that beneath the London Basin, but southwards it runs out beneath the cliffs into the sea. At the Brighton Water Works it wells up in such abundance that the excess has to be run off into the sewers to avoid flooding of the station, and at Portsmouth it supplies the deep wells sunk through the dense alluvial deposits in the forts raised on artificial foundations in the bed of the Solent.

This is a typical example of what I have called a water-supply running naturally to waste, and I believe that London might with confidence draw largely on this for its supply of potable water. But there is reason to believe that a like condition will be found in the chalk hills of North Kent, between Farningham and Chatham, or even so far as Faversham and Wye. The dip of these beds is northwards, but it is only on the southern escarpment that rivers arise. At the same time deep wells in Essex do not yield the abundant supply that those in Hertfordshire afford, and hence I infer that much of the water finds its way into the estuary of the Thames, and, coming under my category of waters running to waste, might be without scruple impounded for the use of the metropolis.

I have heard that this view as to the destination of the North Kent water was warmly maintained by the late Professor Ansted; and I cannot agree with those who ascribe the high proportion of chlorides and nitrates in the water of the Kent Company to the access of tidal water to their wells, though I admit that such percolation does take place under the pressure of high tides into wells at Grays, and perhaps elsewhere on the Essex side. But it must be borne in mind that the conditions are totally different; the axis of the trough in the lower cretaceous beds, towards which the deep waters gravitate, being further to the north, the strata on the Kentish side dip from the land towards the river, but on the Essex shore from the riverside landwards, though in most places the percolation of the salt water would be impeded by the deep alluvial deposits in the river bed.

It is highly probable that in the vicinity of other maritime towns, where ranges of hills run parallel to the shore and their stratification is inclined downwards towards the sea, such sources, hitherto neglected, might be revealed by careful investigation. The objections, economic and hygienic, to the use of rivers, except at their upland sources, of lakes in highly-cultivated and populous districts, and of wells when the land is robbed thereby, are, I maintain, each and all indisputable.

On Maps showing the Area of Chalk available for Water-supply in the Central and Eastern parts of the London Basin.

BY

W. WHITAKER, B.A., F.R.S., F.G.S., Geological Survey of England, Assoc. Inst. C.E., Assoc. Soc. Med. Off. Health.

These maps* are on the old Ordnance 1-inch sheets, and they could be made only for those regions of which the Geological Survey has published Drift maps. As yet, their southern boundary is the range of the North Downs, in Kent and Surrey; their northern, the coast of Norfolk; and their western, the line of the Chalk hills from Hunstanton southward, and then south-westward to beyond Royston, whence there is a temporary gap to Berkhampstead, the line being then continued in the same direction for several miles till it is abruptly turned S. along the edges of Sheets 7 and 8 of the Ordnance map, through Henley-on-Thames.

The maps have four distinct colours, and one of these is divided into two tints:—1. *Red:* Bare Chalk. 2. *Orange:* Chalk, covered by permeable beds only; or tracts in which, therefore, water from the surface can readily find its way into the Chalk. 3. *Green:* Chalk protected by beds of mixed or of varying character; consisting of tracts where surface-water is either greatly hindered in its downward course to the Chalk, or in which it is sometimes free to sink down and sometimes cannot do so. 4. *Grey:* Chalk protected by impermeable beds, forming tracts where surface-water is cut off from direct access to the Chalk by impermeable beds, not only at the surface, but anywhere between the surface and the Chalk. As, however, there are many parts where water flows over impermeable beds to the Chalk, or to permeable beds directly over the Chalk, and as such water then generally sinks, to some extent, into the Chalk, this division has two tints, the paler one for those parts where the drainage is toward the Chalk, the darker for those where the drainage is away from the Chalk.

The result of the whole is that the area of Chalk which may be reckoned on as available for a gathering-ground of water is much less than has often been estimated from an examination of ordinary geologic maps on which the Drift is ignored.

* The maps referred to were exhibited in the entrance hall of the Jermyn Street Museum.

The Influence of Ground-Water upon Health.

BY

BALDWIN LATHAM, Mem. Inst. C.E., Mem. Inst. M.E., F.G.S., F.S.I., F.S.S., P.R. Met. Soc.

The examination of the historic records or of the published Mortality Tables of this and other countries shows that there are certain conditions which are found to be present when certain diseases are most rife. It is also found that, after eliminating certain meteorological and other influences which are supposed to affect disease, some particular diseases appear to be solely influenced by the hygrometric condition of the ground and the volume of water which is present in the ground.

In historic periods when particular epidemics have been rife, they have mostly occurred in times of drought, in which it has been established beyond doubt, by the evidence of the failure of springs and rivers, that the ground-water was then exceptionally low.

The actual measurements of the ground-water in this country, in some cases, go back for a period beyond that of the registration of death; consequently a comparison can be made between the state of the ground-water and the death-rate of any particular period, and when such examination is made it is found that there is a coincidence between the state of the ground-water and the deaths recorded. The deaths follow, as a rule in the inverse ratio, the state of the lowest ground-water; that is, high ground-water indicates a healthy period, while low ground-water marks the unhealthy periods. Investigations respecting the influence of ground-water upon health should be studied over limited areas, as the distribution of rain is often very local, and there are varieties in the geological character of the soil that affect the result of observations carried on over large areas; and on this account, while observations have been carried on by the author over an extended area, he has always used local observations to compare with the mortality returns in the same district, and he has specially dealt with the records of Croydon, which is the place where the observations as to percolation, evaporation, and the hygrometric condition of the soil have been locally studied.

There is every reason to believe that the ground-water itself, except when polluted, exercises no influence as a cause of disease, but that it is merely the measure or indicator of the influences which are at work within a polluted soil, and of certain organic changes which evidently take place within the dark recesses of the soil, and which lead to the development of the conditions favourable to a certain class of disease. That the earth does exercise a baneful effect upon health is well known

from the experience in this country of the unhealthiness of cellar dwellings, and from the fact that persons habitually living upon ground floors are not so healthy as those living in the upper stories of buildings removed from the influence of the ground.

There is a seasonal fluctuation of the waters in the ground, and, as a rule, these waters are lowest in the autumn and early winter, and highest in the spring or early summer; but in some years the periods of both low and high water vary as, for example, the low water of last season did not take place until February of this year (1891).

It is also known that the artificial lowering of the subsoil waters of a district has produced the same effects upon the health as occur when a general lowering of the ground-water arises naturally from drought.

The actual drying of the ground is a condition which is favourable to the general good health in this country, and this circumstance often masks, in the general death-rate, the potential influence of certain diseases, so that the general health of a district appears to be good while at the time it may suffer intensely from a certain class of disease of which low ground-water is the indicator. When, however, the conditions become extremely intense, and the ground-water exceptionally low, the influences at work affect the death-rates as a whole. On the other hand, in periods of excessive rain with high ground-water, the conditions are usually favourable to health, and all places in which the ground-waters are of an uniform level, such as seaside places, which are governed by the mean tide level, and river valleys with porous soils, like that of the valley of the River Wandle, in which the water is headed up to an uniform level by mills, are usually healthy.

It is known that the measure of the effect of the ground-water is most marked in districts which draw their water-supply from the ground, and amongst that section of the inhabitants who use such water for dietetic and other purposes, especially in the case of young children and "teetotalers."

The unhealthy time after the period of excessive low water is that when the first rain begins to percolate through the soil, just as if it washed out matters which had been specially prepared or were retained in the dark recesses of the soil, into the water, or drove out the ground-air specially charged with the poison of disease. It is by no means uncommon both in this and other countries to find that particular epidemic outbreaks which have become rife at a low-water period can be traced to particular rainfalls. In this country since we have had the registration of deaths, those quarters of the year when percolation has first commenced after periods of exceptionally low water are, without exception, the most unhealthy seasons that have been recorded. The quarters of the year when percolation first commenced after exceptionally low water have been the most unhealthy, as for example, the March quarters of 1838, 1845, 1847, 1853, 1855, 1864, 1865, 1866,

1875, 1890, 1891, which, with the exception of the third quarter of 1849 (the cholera year), are the most fatal seasons on record.

There is no doubt that the sanitary condition of the district greatly influences the results of the movements of the ground-water, and the greater the amount of disturbance or the number of disturbances of the ground-water in the course of the season in insanitary districts, the greater and more marked the influence upon health, until the period arrives when the soil has been washed free from its impurities and comparatively pure waters have accumulated in the ground.

Certain diseases have their allotted seasons and conditions favourable for their development and spread, and there are a number of diseases usually most rife when the ground-waters are low, such as enteric fever, cholera, small-pox, diphtheria, and others.

The state of low ground-water, as being a condition accompanying epidemics of typhoid fever, is a matter of constant observation, and it is a well-authenticated fact that all epidemics of this disease in this country have occurred in periods only of low water, or when immediately following a very low state of the ground-water. Ground-water influences both small-pox and diphtheria in a most marked manner, but in directly opposite ways, so that when one of these diseases is present the other is absent. Small-pox is accompanied or preceded by intense dryness of the ground, while diphtheria occurs only when the condition of the ground is one of continued dampness. The year 1871 was a very fatal year from small-pox in this country, and in that year the percolation experiments showed that the ground was intensely dry. In 1876 an outbreak of small-pox occurred at Croydon, and continued until the Autumn of 1877. Outbreaks of this disease have subsequently occurred in this place in 1881–82 and 1884–85. Since September 1885, there have been no deaths recorded from small-pox in Croydon, but diphtheria has been very prevalent during the whole of that period, and the ground has been in a constant state of dampness, so much so, that with the exception of one month, October 1886, a measurable quantity of water flowed from the percolation gauges every month during all this long period. The last outbreak of small-pox, in 1884–85, was preceded by seven months, and that of 1881–82 by five months when no water percolated through the ground. Since the time when the author first observed this marked coincidence between the dryness of the ground and outbreaks of small-pox, he has learned from the report of Surgeon-Major G. Hutcheson, M.D., Sanitary Commissioner of the North-Western Provinces and Oudh, that the counterpart of this has been observed in India in reference to small-pox, which, it is stated, "is "controlled or kept in abeyance by damp and moisture."

The most marked incident in connexion with ground-water is the remarkable parallelism between the deaths of children under five years of age and the lowness of the ground-water; in fact, it is found that the deaths in this case fluctuate inversely in proportion to the volume of the water in the ground.

The following figures give the level of the lowest ground-water, and the death-rate of children under five years of age at Croydon, calculated upon the numbers living at that age :—

Year.	Depth of Water in Wickham Court Well.	Death-rate of Children under 5 Years.
1872	9·00	54·71
1873	20·00	47·15
1874	7·75	51·52
1875	6·08	57·27
1876	7·00	50·98
1877	25·75	47·18
1878	21·83	51·36
1879	31·00	44·57
1880	19·50	50·11
1881	22·08	45·17
1882	18·42	54·84
1883	17·74	41·57
1884	7·33	50·76
1885	5·17	48·90
1886	10·75	40·72
1887	6·44	42·90
1888	9·92	35·72
1889	8·58	38·78
1890	4·00	52·56

In 1882 the excess of deaths was no doubt due to the direct pollution of the water-supply of the district. And it should be observed that since 1884 the low waters in this well are lower than would be the case naturally, as since this period the waters have been abnormally lowered by the establishment of the New Croydon Waterworks Company's station at Addington. If the deaths from diarrhœa are eliminated, as being affected more by temperature than by conditions affecting the state of the ground-water, the parallelism between the volume of water in the ground and the death-rate becomes even more marked.

This coincidence between the rates of mortality of children and ground-water occurring period after period is tantamount to positive proof that ground-water, at least, if not the direct cause, is the measure of the influences at work which seriously menace the lives of young persons.

Those who require further information upon this subject will find it in the Author's recent Presidential Address to the Royal Meteorological Society.

Drainage and Irrigation of Land in their Relations to Health.

BY

RICHARD F. GRANTHAM, M.I.C.E.

At the Brighton Congress of the Sanitary Institute, Sir Thomas Crawford, in his presidential address, remarked, "Putting aside the West "Coast of Africa and other pestilential spots specially dangerous to "life, 'we may confidently say there is not a spot on the globe where "'men may not be kept in health and vigour by proper attention to "'hygiene.'"

It is obvious that the possibility of rendering nearly all lands salubrious, suggested by this remark, would be largely due to the agency of drainage in one form or another. We have heard much of late years of the drainage of towns and houses, and of its beneficial effects upon the public health; and many papers on the subject, as the transactions of the Sanitary Institute bear witness, have been read and discussed. But the subjects of drainage and irrigation of land in their relations to the health of the inhabitants of the country have not been as much discussed, although allusion has been made to them in the presidential addresses of the late Dr. Antonio Brady, Dr. Vivian Poore, and Mr. H. J. Marten. Now, having during some years past been engaged in extensive land drainage operations in the fens of Lincolnshire, and having had experience also in the drainage of irrigation fields in various parts of the country, and looking especially to the fact that of late years works of this kind on a large scale have been carried on in France, Russia, India, and other countries, the present seems to me to be a fitting opportunity for discussing the subject.

It has been shown that decaying vegetable or animal matter under a hot sun in damp soils, swamps, or swampy stagnant pools, however small, is capable of generating the poison of malaria in sufficient quantity to infect those who inhale it, and to cause fever which is often mistaken for and treated as typhoid. Malaria has been defined as air or a mixture of air or any gaseous medium impregnated with miasma, *i.e.*, fine floating particles of poisonous matter exhaled from putrefying vegetable or animal substances, and it produces ague, rheumatism, neuralgia, and intermittent fever in those who dwell in localities where the poison is generated. In the spring of 1879, Signor Tommassi, of Rome, and Professor Klebs, of Prague, who made the subject one of special investigation in the notorious Agio Romano, attempted to discover the physical cause or poison to which marsh or intermittent fevers are due. They allege that the fevers arise from germs present in the soil and floating in the air, and they claim to have traced the particular bacillus which is the cause of the evil. It is related that at Versailles a sudden

outbreak of ague in a regiment of cavalry was traced to the use of surface water taken from a marshy district, and it is likely that in fen districts more harm has arisen from drinking marsh water than from breathing the air.

There are two sources of malaria from marshes: living and dead plants; and when stagnant water contains more vegetable matter than it can oxidize by means of the absorbed air, then some injurious exhalation from the unoxidized vegetable matter is given off.

The testimony of those who have lived in the fens shows that when land is completely covered with water, or when marshes have been completely drained, there is not the prevalence of aguish complaints which occurs immediately after the water level has been lowered by drainage works, and before the effect of these, in thoroughly drying the ground, has been felt.

Intermittent fever, also, has been attributed in tropical climates to the turning up of soil long undisturbed, and Sir Douglas Galton mentions cases at Hong Kong and in the South of France, where fever broke out amongst soldiers and labourers after the excavation of foundations for barracks. Much attention has been given to the subject of this particular fever by the State Board of Health of Massachusetts. In the annual report for 1889, there is an account of inquiries made into its occurrence in various cities of the state. It would seem, according to the report of the medical officer, that returns were received from 152 cities and towns; that in 86 of these cases the fever occurred, and that in 64 of the 86, the cases occurred near ponds, lakes, reservoirs, streams, marshes, drowned lands, upturned soil, and localities more or less infiltrated with sewage. He points out, however, that these conditions are factors only in the outbreaks of the disease and not the cause, for otherwise the exemption from the disease of other towns similarly situated could not be accounted for. The report concludes with the following suggestive remarks: "Grant that it is a truth 'generally " 'accepted that the introduction of a germ is necessary;' grant also " 'that water is almost certain to prove to be the germ's habitat " 'and the vehicle by which this microbe enters the human organisa- " 'tion,' and we have not explained why and how it omits certain " localities and appears in others. This much, however, is true, that " the appearance and spread of intermittent fever in Massachusetts " afford an opportunity for investigation, which, so far as is known to " the writer, has never been systematically undertaken."

In portions of the north-west provinces of India excessive fever mortality has been mitigated by extensive drainage works, by means of which the water which formerly stagnated in the land is now led away by continuously flowing streams. In describing the lagoons in Corsica, the late Dr. Ansted pointed out how the total stagnation and high temperature of so large a sheet of very shallow water produce a rapid growth of confervoid vegetation on the water. This vegetation drifts in enormous masses to the inner shore, where it accumulates and rots. The smell and miasma are carried up the valleys by the prevalent south-

easterly winds, and so poison not only the plains adjacent to the lagoons, but the greater part of the eastern side of the island. In all the valleys the villages are unhealthy and the town of Bastia itself suffers severely; the death-rate of Bastia being nearly 22, while that of the communes north of Bastia, and so out of reach of the miasma, is only from 16¾ to 18 per 1,000. In a Parliamentary report on "the causes of reduced mortality in the French Army serving in Algeria," Colonel Ewart and Dr. Sutherland state that a reduction of the water-stead 20 inches below the level it formerly occupied in a certain district in Algeria, had been followed by a reduction of the annual death-rate from 57 per 1,000 to 24·8, and to a rate even lower still.

Much evidence, both in England and America, has been accumulated to prove that consumption is produced by dampness of site, and that in towns where, through sanitary improvements the soil has become dry, it has diminished. Also Dr. Farr held that on the undrained lands of the lower valleys of the Thames and of other English rivers where their waters are slow and sluggish and thrown out of their channels by milldams, thousands of the population suffer from ague, rheumatism, and neuralgia, while many die of these and other diseases. Drainage of the marsh lands, removal of obstructions to the rivers, and engineering improvements of the water channels, would obliterate countless evils.

Mr. R. B. Grantham, in reporting to the Inclosure (now the Land) Commissioners, upon the "Floods of Somersetshire," stated as the results of his inquiries among the medical men, that during the wet weather of the winter 1871–1872, the public health was good, but that ague set in early in the spring, and was then very prevalent on the verge of the moors, not only among the poorer families but also affecting people in a better class of life. Neuralgia and rheumatism prevail at all times of the year in these districts. Upon the floods retiring, ague is the most common, but zymotic diseases, such as typhoid and other fevers, are rarely to be met with, although with an increase of heat and the great length of time that the waters remained on the land, exposing a large amount of decaying vegetation, intermittent fevers do occur in the moors.

In my own experience in Kent and Essex, I have found ague prevalent in the marshes of the Hundred of Hoo, in the former county, one of my own workmen having been attacked by it; while in Canvey Island, with which I am particularly acquainted, where the surface is from five to six feet below the high tides, ague is now unknown. Camden, in his Britannia, 1607 A.D., however refers to the river having passed through "low and unhealthy" grounds in the island. The river walls are now in good condition, and the drainage well maintained, and the present healthiness of the population is no doubt due to the efficiency of these works. Mr. H. Marten, in his presidential address to the engineering section at Worcester in 1889, stated his opinion that the lowering of the line of saturation, or in other words the lowering of the underground water level, effected by improvements in the drainage of the fens, has a most important bearing on their sanitary condition.

Proceeding now to inquire into the effects of irrigation, I must refer to other countries, viz., Italy and India, for systems on a large scale.

It is claimed for India that she possesses the finest irrigation works in the world. They extend over an area of about 8,000,000 acres, an area considerably larger than the whole of Lombardy, or the surface under irrigation in Egypt. These works have unquestionably conferred immense benefits upon the soil, the climate, and the welfare of the people in preserving them from the effects of drought, but at the same time they have produced serious insanitary conditions. Colonel Baird Smith, in his work on "Italian Irrigation," makes frequent references to the unhealthiness and depopulation by malarious influences in that country. Three kinds of irrigation have been practised there for three different states of cultivation; the ordinary periodical flooding; marcite, or winter flooding, when the land is under flood for a certain period; and irrigation for rice cultivation. The first was carried on without prejudice to health, inasmuch as the water simply flowed over the land and passed off; the second was practised during the winter when the temperature was low and the evaporation small, and the water completely covered the land so that no harm ensued; but the third, that used for rice cultivation, was held to be so injurious to health, owing to the stagnation of the water upon the fields, that laws were passed restricting the limits of such cultivation to three or four miles from the outskirts of any town.

It appears that the evils attending irrigation in India are due to interference by the canals with the natural drainage of the country, and to over-saturation of the soil, resulting in the formation of marshes. Inquiries were made to ascertain to what extent the health of the populations living in the irrigated districts suffered, but it was found impossible to obtain statistics of their previous condition for comparison. It was determined, therefore, to rely on the evidence to be obtained as to the enlargement of the spleen—a certain consequence of malarial diseases. Investigations were made, and it was recommended that, as in the plains of Lombardy, great cities and military cantonments should be protected by zones round them, of from at least three to at most five miles radius, being kept free from irrigation.

It has also been stated on high authority that malarial fever is by far the principal cause of disease and death in India. In 1864 it was reported that the whole area irrigated by the western Jumna Canal required thorough drainage, and that 60,000 acres were affected by "reh" efflorescence. The mortality from fever over the area watered by this canal was so terrible that the cantonment of Karnal had to be abandoned. Again, in 1867, it was reported that from 61 to 80 per cent. of the residents were suffering from spleen disease. Dr. Thornton, C.S.I., from whose paper to the Society of Arts, in 1888, I have derived much information, goes on to say that, since his paper was written, "a system of surface drainage is being carried out; but "surface drainage, though valuable and important, merely provides an "outlet for surface waters, and is no remedy for excess subsoil water "resulting from constant irrigation added to the natural rainfall. The "proper remedy is subsoil drainage; but subsoil drainage has not yet "been attempted."

From the evidence thus adduced we are enabled, in some measure, to appreciate the wide extent of land subject to the influence of malaria, and the degree to which inhabitants are affected by it. It will have been observed that malaria is prevalent not so much when the land is completely covered with water as when the water has partly evaporated, or been partly drained off, and the decaying vegetation, in a damp state, is exposed to the heat of the sun. Further, that in winter, the danger is less than in the spring, when evaporation becomes more active.

The only safe conditions as regards health upon which irrigation of any kind can be allowed, lie in its flowing on, to, and off or through the land without being permitted to stagnate; and, where the subsoil is of a retentive nature, or the surface is so flat that water cannot escape, in providing subsoil drainage with proper falls to facilitate filtration, and so avoid stagnation.

Thus far we have considered the varying conditions under which drainage and irrigation exercise an influence upon health, and have seen that, by the proper drainage of marshes, naturally formed, and of swamps, created by irrigation works, malarious diseases will die out. But, although this is the chief benefit of efficient drainage, it is also accompanied by considerable increase in the prosperity of the country, the soil, when drained, being mostly very rich, and fit for profitable cultivation. I propose to refer to some important instances.

Looking abroad, we find several encouraging examples:—In France, near the mouth of the La Gironde, not far from Bordeaux, the drainage and improvement of 1,500,000 acres of desert land has been steadily progressing, and in the plains of Forez, on the banks of the Loire, in the basins of the Mare and Vizezi, works of drainage and irrigation have been carried out over an area of about 100,000 acres; the increase in the value of the land in the basin of the former river having been reckoned at 25 per cent., and in that of the latter at 48*l.* 11*s.* per acre. The cases of fever have been much diminished in number and severity.

Again, in Southern Italy, the marshes near Fondi used to produce pestilential exhalations during the summer months which, it is said, infected and poisoned the atmosphere for miles round. The total area of the marshes was 12,000 acres, of which at least 10,000 have been drained since 1882, and are now under cultivation, and let freely at 5*l.* per acre.

In Russia, the drainage of the Pinsk marshes, on the Russo-Polish frontier, containing about 25,000,000 acres, and said to be the biggest bog in Europe, has been steadily carried on at the rate of about 400,000 acres per annum.

Mr. Bailey Denton, in 1861, stated that the total area in Great Britain, undrained or capable of improvement by draining, was estimated at 22,800,000 acres out of a total of 56,352,000 acres, while the area drained at that time did not amount to 1,500,000 acres. This, however, refers to under or subsoil drainage, and it is not to be supposed that the

undrained remainder of 21,300,000 acres would represent surfaces yielding malarial exhalations. But that great benefit would arise to health if that area were drained cannot be doubted. Now, where the subsoil of marshes or swamps is of a retentive character, arterial or surface water drains alone, as pointed out by Dr. Thornton, will not always be sufficient. The surfaces may be so flat that, in wet seasons, the water will rest on them without any chance of escape into the arterial drains.

In view of the importance of the subject, it will be worth while to describe the operations I referred to at the commencement of the paper, which have been recently carried out in the fens and marshes of Lincolnshire.* In the marshes a fine system of arterial drainage exists, and, therefore, no difficulty arose as to outfalls. But, as I have already remarked, the soil being close and retentive, with a very flat surface, and with fields measuring perhaps 100 acres or more without any drain or ditch, the water, in wet seasons, lay for months, thus reducing large and highly cultivated areas to the condition of swamps.

The subsoil of the fens is quite distinct from that of the marshes. That of the fens in which the work was carried out consists of stiff dark brown and blue alluvial deposit, with some beds of black earth or peat, and here and there beds of silt, which form small knolls, one or two feet high, above the surrounding land. The subsoil of the marshes, however, is formed of silt or sandy deposits more or less consolidated, and originally brought in by the sea, containing layers of decayed vegetation which has grown and perished under each successive accumulation of sand.

The wet seasons, which lasted without intermission from 1875 to 1883 inclusive, reduced a large part of these fens and marshes to the condition of swamps. Ploughing and sowing could only be carried on under the greatest difficulty, and a large part of the crops was frequently lost and the pasture lands a good deal deteriorated.

In the fens, open drains already existed which afforded outlets for pipe drains. In the marshes it was found necessary to divide the field into smaller areas by cutting large arterial drains with a level bottom about 5 feet below the surface of the land. By this means it was found possible to give an artificial fall in the absence of any natural one. In this way efficient drainage became practicable, although, owing to the slightness of the falls, extreme care was necessary in laying the pipes.

In the fens, the main pipes were laid about 3 feet below the surface, with the small fall of about 1 in 2,000, and the minor pipe drains were laid at an inclination of about 1 in 1,600. In order to ensure accuracy in cutting the bottoms of the trenches for the pipes, the water in the open drains was dammed up into them before any pipes were laid.

* It may be observed that arterial drainage can only be applied to suit the circumstances of the particular case, while agricultural or subsoil drainage is similar in its character wherever adopted, although its adaptation to various soils requires discrimination.

When the bottom had been proved, the main pipes, which were larger than would be used in ordinary pipe drainage, were laid, and the minor pipes were connected with them, and laid in the usual way. Where the subsoil was alluvial deposit, and the surface level was irregular, the drains were laid in the "hollows" or "lows;" where it was flat, they were laid at distances of 24 and 27 feet apart; while the depths varied from 2 to 3 feet, the greatest obtainable.

In the marshes the main arterial drains generally fairly discharge the water that comes to them. In excessively wet seasons, however, owing to the deficiency of open ditches and of pipe drainage, the water could not for a long time reach them, and the land was meanwhile almost submerged. The outlets of the main-pipe drains were laid 3′ 6″ to 3′ 9″ deep, below the surface, and with a nearly level bottom. The main pipes were laid in a similar manner to that in the fens. The widths apart, however, between the minor drains, varied from 36 to 66 feet, according to the stiffness of the subsoil.

The cost of pipe-draining the fens varied from 3*l.* 16*s.* 3*d.* per acre to 5*l.* 10*s.* 10*d.*, and the marshes from 2*l.* 16*s.* 1*d.* to 3*l.* 0*s.* 9*d.* per acre.

I have endeavoured, in this paper, to bring forward from various parts of the world, evidence of the important sanitary and commercial results of efficient drainage of marshes, low-lying lands, and, to a great extent, irrigated lands. It would be difficult, if not impossible, at the present time, to obtain accurate statistics of the relations of the drainage and irrigation of land to health; but, I venture to think, even the statistics we have indicate how largely those operations influence the sanitary condition, and how much they conduce to the prosperity of such districts. There appears to me, therefore, to be good grounds for suggesting further investigation and the collection of precise records of the diseases incidental to these marshy localities.

DISCUSSION.

Mr. Baldwin Latham said that there could not be a shadow of doubt as to the fact that, in India, wherever irrigation was carried out, malaria followed it; but the question of drainage was one of considerable difficulty. It was not so easy as many persons in this country imagined, for very often the water-line was 20 or 30 feet below the surface in the irrigation district (during the low ground-water period of the year), and it was almost impossible in such districts to deal with the question of water-supply. Again, the black soils of the plains of India were so remarkably retentive, that if subsoil drains were put in only 20 or 30 feet apart, they had little or no effect upon the intermediate space. The experiments that had been made conclusively showed that the work of drainage, in the ordinary sense of underground drainage, would be extremely expensive and difficult to undertake in India. Of course very much could be done to ameliorate the condition of affairs by proper arterial drains for the collection of water after irrigation, making them

as deep as possible. That had been followed out in a very great measure in many parts of India, and recently in the case of Poona, where an un-irrigated zone had been fixed around the city to prevent the ill effects following the application of water to the surface of the soil. By establishing those zones in the neighbourhood of a populous district, the influences were ameliorated to some extent. The real cause was hardly yet understood, but he thought that the effect was in a great measure due to the dampness of the ground, and to the exhalations at night from the irrigated areas. It was well known in India that malaria was rife at night. In the day-time one could traverse most malarious districts with impunity, but it was extremely dangerous after nightfall. Owing to the high temperature of the ground in India, especially when moist, after rainfall, when the temperature was much lower, exhalations were given off, and with those exhalations probably the malaria was exhaled. With regard to the fens of Lincolnshire, he knew very little about them, but he had been engaged for many years in the fens of Cambridgeshire. The soil of those fens was so remarkably light that no drainage at all was necessary. It simply consisted of decayed peat. A great point in those districts, in a dry season, was the constant habit of letting water in from the rivers which were at higher levels than the land, in order to maintain a uniform level of about three feet below the surface-level. When the water got above that it was pumped out, and when it fell below, as in seasons of drought, the water was let in. Ague was almost unknown since the more complete drainage of the fens; and what might be necessary where the soils were of a silty, alluvial character, was by no means necessary in the larger part of the fens of Cambridgeshire, where the soils were of an exceedingly light character, principally decayed peat lying on the top of Kimmeridge clay, the only manuring being done by digging down and throwing out the clay and mixing it with the surface soil.

Mr. T. H. Thornton, C.S.I., formerly Secretary to the Government of the Punjaub, was exceedingly pleased that Mr. Grantham had called public attention to the very serious results attending the extension of canal irrigation in India, especially in northern India, when unaccompanied by adequate drainage. Speaking from memory, he believed he was right in saying that every year, in British India alone, the deaths from malarial fevers amounted to several millions; and it had been clearly shown that no small portion of that mortality was attributable to malaria developed in canal-irrigated areas. According to Colonel Crofton, the distinguished canal engineer, the introduction of an irrigation canal in Northern India had the effect of adding to the natural rainfall about 70 inches of water per annum. It was clear that, if no special measures were taken for the drainage of land receiving that enormously increased water-supply, the result must be very serious—at any rate, in lands without a porous subsoil—and so it had proved. No doubt there were great difficulties in the way of providing subsoil drainage in India, but there were some measures contributing to the prevention of malaria which were quite practicable and should be introduced. One measure suggested for the prevention of the development of malaria from canal irrigation was to sell the water by strict measurement. At present one great cause of malaria in India was the fact that the peasantry over-irrigated their fields. The reason was that they did not pay for the water according to the amount supplied to them. They were allowed by the subordinate officials to have so many waterings, but the amount of

the waterings was not regulated, and the result was, that wherever there was irrigation there was more or less over-saturation. If they could only make it the peasant's interest not to over-saturate, malaria would be diminished. The Government of India had had the question of water measurement before them for years, and many water-meters had been tried, but none had proved satisfactory. They had either been too expensive or too delicate, and the condition of their having to be applied to a rising and falling canal made the matter very difficult. Still, he hardly thought that it was a matter beyond the possibility of invention in the present day. Another preventive measure was to prohibit the supply of water from irrigation canals on what was called the high-level system, by which the water is allowed to flow onto the soil by the force of gravitation. Every peasant who used water from the canal should be required to lift it. Even if he had only to lift it one foot, the extra labour involved in doing so would secure economy, and prevent, *pro tanto*, the over-saturation which produced such terrible effects upon the health of the population. Such prohibition, at any rate, should be enforced in all fever-stricken districts, and in the neighbourhood of all towns. He was glad to learn from the previous speaker that in the cantonment of Poona a zone had been established in which no irrigation was allowed. The measure he had suggested did not go so far as that, but he was inclined to think that it would be as effectual. It had frequently been proposed by experienced administrators in India, but hitherto it had not been adopted, mainly for financial reasons, because the amount of revenue derived from low-level irrigation was not so great as that from high-level irrigation; but surely, when the lives of people in towns had to be considered, the question of revenue ought not to stand in the way.

Mr. William Harpur, M.I.C.E., said he had been much interested in the last two papers, which had clearly shown that the public had not only to look to the defects in ordinary house drainage as affecting the public health. There was a general opinion amongst the public that if any case of sickness arose, it must be due to defective house drainage. It appeared, however, from the papers that had been read, that there were other elements at work which more or less affected the public health. It was only necessary to bring the matter more to the notice of the general public in order that they might be acquainted with the facts, and so understand that there were other elements than those generally regarded as affecting the public health. In the town of Cardiff, in which he lived, they had two very distinct kinds of subsoil. The northern portion of the town lay upon a substratum of gravel, the southern portion was entirely upon an alluvial deposit of clay, which was perfectly impervious; and it was a fact which could be borne out by statistics for many years past, that the death-rate was higher in the southern portion of the town, built upon the impervious stratum, than it was in the northern portion where the soil was light and the drainage good. The question of subsoil drainage was one which, undoubtedly, should be taken up much more than it had been. There could be no doubt that the health of the people was governed to a very great extent by the condition of the water in the ground upon which the town was built.

General R. Maclagan said that, in connexion with irrigation in India, the result, he thought, might be stated thus: that the sickness which occurred in the irrigated districts was due to the abuse of irrigation, and the excess of irrigation, not to the simple fact of irrigation itself. It

was true that sickness had followed the course of the construction of many canals, but that was chiefly due to an important fact, mentioned in one of the papers, that the canals in many cases intercepted the natural drainage of the country, and therefore produced marshes and sickness, where there ought not to be either. It should be mentioned, in connexion with certain canals where the greatest amount of unhealthiness had occurred, as referred to by the reader of the paper, and by Dr. Thornton—the Western Jumna canals—that those canals were constructed by the Mohammedan emperors of India, one of them upwards of 500 years ago. One of their endeavours, with very defective means of ascertaining the levels, and so on, was to supply the water on the natural surface of the ground, so as naturally to produce the effect which Dr. Thornton had mentioned. It was given so easily that the cultivators used it in excess, and thus produced a very large amount of malarial marsh, which led to sickness. The canals being raised above the surface of the land produced two effects. The water sank into the ground, and, at certain distances from the canal, it rose again towards the surface. The first effect was the production on the surface of the soil of a saline efflorescence, consisting almost entirely of sulphate of soda, which rendered the soil for the time barren. The next effect of the percolation of water was the production of those unhealthy marshes. The Government having investigated the matter, and having seen how much the excessive irrigation was the cause of sickness, and how much evil was produced by the percolation from the canals which were raised above the natural level of the country, had corrected this old canal by bringing the whole of it "within soil," as it was termed. Facts were being collected, and still more facts were required to enable them to correct the many existing defects of the old canals. He desired to confirm what had been said by other speakers as to the extreme importance to India of an abundant water-supply for cultivation. And as to the subject of the effect of irrigation upon the health of the community, he could assure his hearers that the Government of India was quite alive to the necessity of ascertaining further facts, and of applying further remedies.

M. Maignen said he wished to explain why the death-rate of children was greater when the water was low than when it was high in the wells. The maritime stations of France, from time immemorial, had yearly been afflicted with typhoid fever in the autumn and winter, the time when the recruits arrived. At L'Orient, since precautions had been taken, there had not been one case of admission of typhoid fever to the hospital. Four miles from the port of Brest, where no such precaution had been taken, there had been 250 deaths in a month at one barrack. It was the old hospital of the prison. There were four long sheds, covered in the middle, and between the sheds there were w.c.'s, and a big drain. The water falling from the sheds remained stagnant. It was a plateau surrounded by walls, and there was no escape for the water. There was a central drain at each corner of the four sheds, a well, and a pump, and that was the only supply for the men in the barrack. For 20 or 30 years there were 1,200 men in that barrack, but suddenly the number was increased to 3,000, and from that moment they drew three times as much water; the wells were the natural place for the water and the mud that had been stagnant for 20 or 30 years to flow into, and those unfortunate men actually drank the water that had been stagnant in that superficial area for that time. As the water went lower down in the wells, more water came into the wells from the upper strata. The germs had been long in a dormant state, and deprived of the light which was

necessary to the purification of polluted water, and they were only brought to real life when they were subjected to the heat of the body. Two processes of water purification had been referred to, the shaking-up of iron with the water, and sand filtration. That which was done by shaking-up iron and water might be done by other means. It was not a bad method, but it was, he thought, expensive, and the same thing could be done by the cheaper method of throwing a salt of iron into running water. After revolving, the water was sent over into decanting tanks, and exposed to the sun. That, again, was a bad thing, because the light came and helped to multiply the microbes and the vegetable matter, which warmth multiplied so quickly. With regard to sand beds, they well knew that sand beds did not remove all suspended matter. In Berlin, the water was yellow, and by simple, proper, mechanical filtration, that yellow colour disappeared.

Mr. R. F. Grantham, in reply, said he quite agreed with what Mr. Baldwin Latham had said as to the Cambridgeshire Fens. As to the black peaty soil in India, mentioned by Mr. Baldwin Latham, that gentleman had said that it was so stiff that perhaps drainage could not be carried out without great expense. There were very few soils, he should say, stiffer than some of the English clays, and from his own experience he had no doubt that the drainage could be carried out at a reasonable cost, to the immense benefit of those clay soils. With respect to what Dr. Thornton had said as to remedies, he (Mr. Grantham) spoke with all deference as to limiting the quantity of water by measure. He thought if anyone would read Captain Baird Smith's book, on the subject of Italian irrigation, he would find the immense difficulty there was in providing a meter that would really accurately do its work, and measure out the water equally to all parties, or in their respective proportions. That seemed to him one difficulty about limiting the water; but no doubt the lowering of the level of the canal a little below the soil, and making the peasant lift the water a little, would be an immense improvement and an amelioration of the difficulty. In a great many irrigation grounds in this country, subsoil drainage would be of great benefit, although they did not receive an excessive amount of water. He quite agreed with the speaker who said that it was very necessary to look after sub-soil drainage round towns. He had referred to a paper by Dr. Ansted, in which he described the great harm which some lagoons in Corsica created, by the malaria going up from them; the inland towns being healthy, while those parts of the country near the lagoons were much affected by the disease.

Herr Kümmel said that in Altona, with its mechanical sand-filtration and its regular bacteriological examination, it was found that the average was not more than 20 microbes per centimetre, and very often there was no microbe at all. The water of the river had many more microbes than the Seine. The rate of 5,000 was very low, the common rate being 20,000. He therefore believed that mechanical filtration could not be so bad as had often been stated.

Projets pour l'Alimentation en Eau Potable d'une grande partie de la France au moyen de l'Eau des Lacs de Neuchâtel et du Léman.

PAR

M. Guillaume Ritter, Ingénieur, Neuchatel.

Provenance et qualité des eaux.

L'eau du lac de Neuchâtel captée à 100 mètres de profondeur serait celle destinée à Paris et aux villes et villages des départements traversés par l'aqueduc dérivateur, elle pourrait au besoin être distribuée jusqu'aux environs de Rouen.

L'eau du lac Léman ou de Genève, toujours captée à 100 mètres environ de profondeur, serait celle destinée à Lyon et aux villes et villages de la vallée du Rhône; jusqu'à Orange, elle serait distribuée au moyen d'un grand aqueduc dérivateur central, puis de là, au moyen de deux embranchements principaux, elle serait dérivée du côté ouest jusqu'à Nimes et Montpellier et du côté est jusqu'à Marseille, avec possibilité de la distribuer au delà de ces villes du littoral méditerranéen.

Le bassin hydrographique qui alimente actuellement le lac de Neuchâtel au moyen de l'Aar qui y jette souvent ses eaux par le lac de Bienne, est de 8,331 kilomètres carrés d'étendue.

Le bassin hydrographique du lac Léman est de 7,995 kilomètres carrés.

Donc, le partage entre les deux réseaux de dérivation sera presqu'égal comme puissance d'alimentation, au point de vue de l'étendue des surfaces alimentaires, des bassins récepteurs et de l'eau d'alimentation.

L'eau des lacs suisses, dont il sagit ici, est d'excellente qualité quoiqu'elle soit assez riche en matières organiques, mais celles-ci sont complètement oxydées dans les couches profondes où on ne recontre *jamais* à l'analyse aucune trace d'ammoniaque ni d'azotites, ce qui n'est pas le cas pour les couches très superficielles. La différence de densité entre l'eau des couches superficielles et celle des couches profondes toujours à quatre degrés centigrades en hiver comme en été, rend tout mélange des eaux de surface impossible avec celles à 100 mètres avant plusieurs années, c'est à dire avant une oxydation et une purification infiniment plus complètes que celles des eaux de pluie alimentant, n'importe quelle source souterraine.

La meilleure preuve expérimentale de cette qualité parfaite des eaux est l'expérience faite à Zurich et à Genève depuis plus de 50 années, villes de 60,000 et 70,000 habitants, exclusivement alimentées avec l'eau de leurs lacs, et cependant l'eau y est captée à quelques mètres seulement de profondeur.

Les édilités de ces villes n'ont eu qu'à se féliciter du système d'alimentation adopté, depuis que l'on a éloigné du rivage immédiat les tuyeaux aspirateurs de l'eau; il est vrai qu'il manque à ces eaux la fraîcheur en été, ce qui ne sera pas le cas pour les eaux du projet Ritter captées à 100 mètres de profondeur et ayant quatre degrés seulement de température à leur origine.

La basse température de l'eau permettra de distribuer celle-ci à Paris à 9 ou 10 degrés et à Montpellier et Marseille à 10 ou 12 degrés. L'eau captée dans les lacs si profondément, est presque indemne de microbes ou germes vivants: lorsque M. Ritter a présenté à Paris son projet pour ce qui concerne cette ville, cet ingénieur a prouvé victorieusement, que l'eau proposée, captée de 50 à 100 mètres de profondeur, renfermait considérablement moins de microbes que les eaux de la Dhuis et même que les eaux si réputées de la Vanne employées pour l'alimentation de la capitale.

Dans l'opuscule publié sur ce sujet et rendant compte de la communication de M. Ritter à la Société des Ingénieurs Civils de France dont il fait partie (voir tome d'août 1888 des bulletins de cette société), il se trouve tout un chapitre concernant la démonstration de l'excellence de l'eau des lacs suisses captée à une grande profondeur.

En résumé M. Ritter conclut en disant que l'eau proposée captée dans les conditions de profondeur indiquées ci-dessus, est pour de gros volumes, la meilleure qu'il soit possible de se procurer, car elle est véritablement minéralisée par son séjour de plusieurs années dans les couches profondes, très chargée d'air qui se dégage abondamment quand on la ramène à la surface, enfin parce qu'elle est absolument débarrassée de toute matière organique non oxydée ou en voie d'oxydation comme aussi de tout germe nocif vivant.

Volume des eaux disponibles.

La puissance alimentaire du lac de Neuchâtel sera mise à contribution à raison de 30 mètres cubes par seconde, ce qui représente *un dixième* environ du volume moyen débité par l'Aar avant son entrée dans le lac de Bienne par le nouveau canal de Hagneck.

Avec 30 mètres cubes par seconde d'écoulement, les trois lacs de Neuchâtel, Bienne et Morat, qui en réalité ne feront qu'un seul réservoir, pourront avec une couche de *un mètre* seulement, suffire pendant 138 jours au débit journalier nécessaire de 2,592,000 mètres cubes, soit donc pendant 4½ mois.

Il résultera selon M. Ritter, avec les travaux de parachivement qu'il a prévus dans son projet, des canaux de correction des eaux des lacs du Jura; une amélioration sensible de la navigation; des variations de niveau moins considérables; enfin comme pendant les basses eaux de l'Aar, la réserve des lacs servira seule à l'alimentation de l'acqueduc adducteur des eaux du projet, l'eau de la rivière suffira très largement aux besoins des quelques usines d'aval en Argovie, qui utilisent une faible partie de ses eaux.

Aucune raison majeure ne saurait être mise en ligne pour faire échec au projet, vu le grand bénéfice financier qui résultera pour la

Suisse de l'exécution de l'entreprise projetée, aux recettes de laquelle elle participera.

Pour ce qui concerne les eaux du Léman M. Ritter prévoit également un prélèvement des 30 mètres cubes par seconde, correspondant à un huitième environ du volume débité par le Rhône à Genève.

La France a incontestablement le droit de prélever ce volume d'eau dans le Léman, toutefois un inconvénient grave se produira de ce côté, à savoir que la ville de Genève ayant mis à profit les idées et projets élaborés par M. Ritter lui-même en 1876, a exécuté un vaste système d'utilisation des forces motrices du Rhône, donnant eau force et lumière électrique à la ville; or il résultera de cet état de choses un conflit, vu le détournement des eaux par une autre voie que celle de Genève. Pour éviter ce conflit M. Ritter a prévu dans son projet un moyen de restituer à Genève la force perdue par le détournement des 30 mètres cubes d'eau prévus; conséquemment pas plus à Genève qu'à Neuchâtel l'eau captée dans les lacs n'offrira des inconvénients pour les riverains de ceux-ci.

Mode de dérivation des eaux et particularités relatives au système.

Les projets de dérivation des deux systèmes du lac de Neuchâtel et du Léman comportent d'immenses aqueducs dont les tracés suivent :—

Pour l'aqueduc de Neuchâtel-Paris, la traversée du Jura depuis Auvernier lieu de captation de l'eau, à Maiche dans la vallée du Dessoubre au moyen d'un tunnel, traversée du département du Doubs et de la Haute Saône en passant au sud de Vesoul, de la Haute Marne au sud de Langres, de la Côte d'Or au nord de Châtillon, de l'Aube près de Bar-sur-Seine, de l'Yonne au nord de Seus, de Seine et Marne au sud de Fontainebleau, enfin de Seine et Oise et arrivée à Paris sur les hauteurs de Meudon.

Pour l'aqueduc du Léman la prise d'eau près d'Yvoire fournira l'eau à un tunnel débouchant près de Bellerive dans les gorges du Rhône, de là l'aqueduc longe le Rhône jusque près de Belley, de ce point se dirige sur Vienne au sud de Lyon, longe de nouveau la vallée du Rhône jusqu'au nord d'Orange.

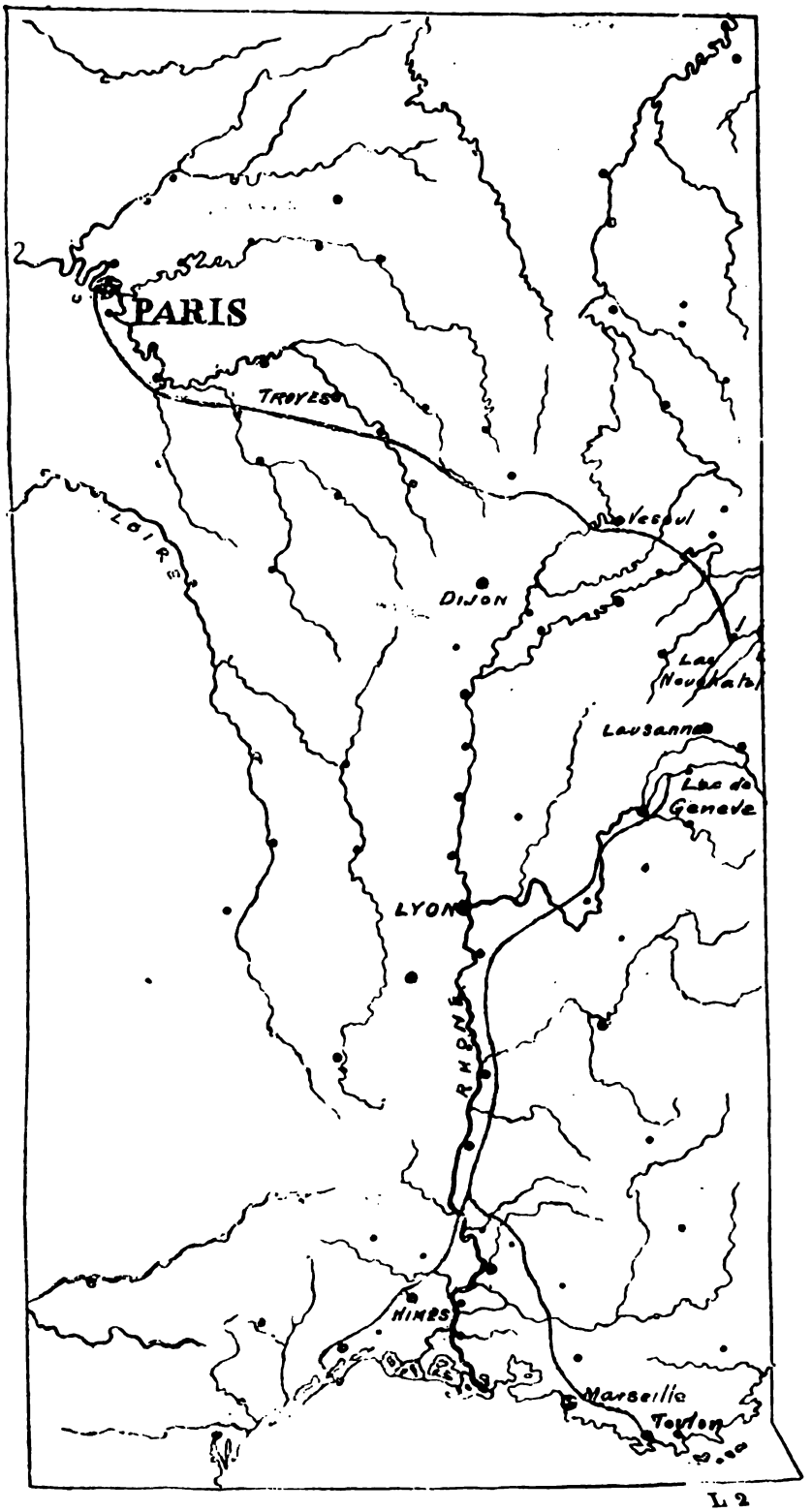
Depuis Orange un embranchement, celui de gauche passe près de Carpentras, l'Isle et Cavaillen dans le département de Vaucluse puis s'infléchissant à l'est aboutit à Marseille.

L'embranchement de droite traverse le Rhône, passe au sud-est d'Uzès, quelque peu au nord de Nimes, au nord de Lunel et se termine sur les hauteurs qui dominent Montpellier.

Les travaux des aqueducs comprennent :—

1°. Des tubes métalliques capteurs des eaux qui débouchent dans les aqueducs, ces tubes seront armés de crépines ou cribles gigantesques à roulettes, que l'on pourra périodiquement ramener à la surface pour leur nettoyage.

2°. Des tunnels nombreux, dont un transjurassique de 37,000 mètres pour l'aqueduc du lac de Neuchâtel, qui sera divisé en


PARIS
TROYES
LOIRE
Vesoul
DIJON
Lac Neuchatel
Lausanne
Lac de Geneve
LYON
RHONE
NIMES
Marseille
Toulon

trois tronçons de 5, 19, et 13 kilomètres au moyen de deux galeries inclinées.

La dérivation du Léman comporte également un tunnel de 40,000 mètres de longueur en terrain quaternaire, mais avec massif superposé de très faible hauteur permettant son exécution avec un nombre illimité de puits.

3°. Des canaux voutés en béton d'une section en général de 18 mètres carrés avec pente variant de 4 à 6 mètres par myriamètre, ils seront exécutés mécaniquement.

4°. L'aqueduc comprend encore comme travaux pour le système du lac de Neuchâtel :—

	mètres.
65 ponts aqueducs d'une longueur de -	118,500
5 syphons métalliques d'une longueur de -	29,500
19 tunnels y compris le grand d'une longueur de - - -	63,300
En y ajoutant une longueur de - -	255,300
Pour l'aqueduc en tranchée et de - -	2,960
Pour les aspirateurs et canaux de jonction on obtient un total de longueur de -	469,560

Soits en chiffres ronds 470 kilomètres.

Les études pour le projet du Léman ne sont point suffisamment avancées pour pouvoir en donner le détail avec précision.

Toutefois on peut approximativement indiquer que la longueur de l'aqueduc du lac à Orange sera d'environ 350 kilomètres ; que l'embranchement d'Orange à Marseille aura une longueur de 140 kilomètres et qu'enfin celui d'Orange à Montpellier comportera 100 kilomètres d'aqueduc environ.

Les hauteurs de charge d'eau disponibles seront—

à Paris de 100 mètres sur la Seine.
à Lyon de 130 mètres sur le Rhône.
à Nimes de 120 mètres sur la ville.
à Montpellier de 100 mètres sur la ville.
à Marseille de 130 mètres sur la mer.

Ces chiffres donnent une idée de la grande force motrice qu'il sera possible de tirer de l'eau, tout en lui laissant une pression suffisante pour être distribuée dans la majeure partie des localités pour l'alimentation et les services publics.

Coût du projet.

	francs.
Le projet de dérivation des eaux du lac de Neuchâtel à Paris coutera avec les intérêts comptés à 3 % pendant les quatres années de construction -	400,000,000
L'aqueduc de dérivation des eaux du Léman depuis Yvoire à Orange coutera - - -	300,000,000
L'embranchement d'Orange à Marseille coutera -	75,000,000
Celui d'Orange à Montpellier coutera - -	50,000,000
Total - - -	425,000,000

Ensemble du coût.

	francs.
Projet de Neuchâtel - - - -	400,000,000
Projet de Genève - - - -	425,000,000
Frais généraux - - - - -	75,000,000
Total - - -	900,000,000

La société qui se chargera de l'entreprise devra posséder un capital d'exploitation pour installer des distributions d'eau dans toutes les localités qui en désireraient ou auxquelles des ressources suffisantes feraient défaut pour les faire immédiatement à leurs frais.

Les avances ainsi faites seraient remboursées par voie d'amortissement lent, dont les annuités seraient formées au moyen d'une augmentation des taxes d'abonnement d'eau distribuée.

On arrivera ainsi rapidement à distribuer et placer l'excellente eau des couches profondes des lacs Léman et de Neuchâtel et à réaliser cette gigantesque et surtout bienfaisante œuvre avec un capital de *un milliard de francs.*

Rendement de l'entreprise.

Pour assurer rapidement la rentabilité de l'entreprise il faudra vendre l'eau à un prix excessivement réduit aux villes qui en ont insuffisamment, par exemple quatre centimes le mètre cube, eau fournie dans les réservoirs de leurs distributions.

Pour les localités où la société distribuera elle-même ses eaux, elle pourra aisément retirer 10 centimes du mètre cube d'eau livrée à domicile, prix inférieur de moitié environ à celui que l'on paie généralement dans les villes les plus économiquement alimentées.

En admettant ces bases on aura, 60 mètres cubes d'eau par seconde à vendre soit 5,184,000 mètres cubes par jour.

	francs.
Au prix de quatre centimes cette eau mise en vente produirait donc annuellement - -	75,000,000
Il faut ensuite compter sur 1,500,000 mètres cubes par jour qui seront distribués par la société et qui produisont au moins quatre centimes de plus, soit environ - -	22,000,000
Enfin le projet prévoit qu'il sera possible de tirer de l'eau ainsi distribuée, une formidable force mécanique au moyen de laquelle on pourra assurer l'éclairage électrique de la plupart des villes alimentées.	
De ce chef on pourra compter sur une récette de au moins - - - -	5,000,000
Le total des recettes sera de - -	102,000,000
Si de ce chiffre de 102,000,000 francs on défalque pour l'entretien du système, les frais d'administration et généraux, etc. - - -	12,000,000
Il restera net - - -	90,000,000

soit 9 °/₀ du capital engagé pour chaque exercice annuel.

Il est bien certain que l'éclairage électrique rendra plus de 5,000,000 car si l'on suppose, que l'on puisse prélever seulement 30 mètres de hauteur sur la chute disponible de Neuchâtel à Paris qui est, de 428 mètres moins 27 mètres, niveaux du lac alimentaire d'un côté et de la Seine de l'autre ; ou que l'on puisse prélever le même chiffre en hauteur sur les 375 mètres de hauteur des eaux du Léman sur la mer, on aurait avec cette chute 60,000 × 30 = 1,800,000 kilogrammètres, soit 18,000 chevaux nets sur l'arbre des dynamos.

Cette force pourra être doublée pendant les heures d'éclairage et alimenter d'énergie 400,000 lampes de 16 bougies, valant 30 f. annuellement l'une, soit donc un chiffre de 12,000,000 annuellement.

Il est encore utile d'indiquer ici, que l'auteur du projet propose d'utiliser parfois la chute d'eau existant entre l'aqueduc et les réservoirs des villes alimentées non pas seulement pour produire de l'électricité, mais aussi pour élever un certain volume de l'eau, dans les quartiers hauts ou même villes voisines plus élévées que l'aqueduc de dérivation.

Ainsi en serait-il à Paris, où Versailles et 65 communes de la banlieue Parisienne, soit plus de 700,000 âmes de population seront éternellement condamnées à ne jamais pouvoir consommer une verre de bonne et pure eau, la ville de Paris comme un vampire malfaisant absorbant et accaparant toutes les eaux des sources environnant la capitale à 200 kilomètres tout autour d'elle.

Tout en alimentant les réservoirs de Montrouge situés à 90 mètres d'altitude on pourra avec l'eau de Neuchâtel arrivant à 120 mètres, utiliser les 30 mètres de chute perdue pour remonter à 160 mètres sur mer, l'eau nécessaire à Versailles et autres localités du la banlieue plus élevées que Paris même.

Il en sera de même dans beaucoup d'autres villes.

Conclusions.

La capitale de la France ruine à tout jamais l'avenir des contrées avoisinantes sous le rapport de l'eau potable, sans jamais pouvoir se satisfaire, l'eau de Seine pendant les mois chauds de l'année est celle consommée tour-à-tour par de nombreux arrondissements de la ville; l'édilité de cette capitale arrive toujours trop tard, avec des volumes d'eau de source nouveaux, enlevés par voie d'expropriation brutale à des populations qui en ont ou en auront infailliblement besoin un jour, cela sans jamais marcher aussi vite que les besoins nouveaux résultant de l'extension de la ville.

Trente mille maisons ne sont point abonnées aux eaux vu le prix élevé et surtout la mauvaise qualité des eaux souvent distribuées en été.

Les eaux d'Avre que l'on dérive en ce moment ne combleront pas les besoins actuels; d'autre part M. Ritter prétend que les arrosages des rues pratiqués avec de l'eau contaminée et saturée de vermines microbiennes sont avec l'eau d'alimentation, une cause de la permanence d'action de la fièvre typhoide à Paris.

Cette fièvre dévore à Paris 80,3 pour 100,000 habitants annuellement, et pour la France entière c'est 83,3 pour 100,000, ce qui dit assez

ou nous en sommes sous le rapport de la bonne eau d'alimentation, alors qu'en Allemagne la mortalité due à la typhoide n'est que de 20,5 pour 100,000 habitants et en Angleterre, 26,7 pour le même chiffre.

Cet état de grande infériorité de la France doit absolument prendre fin, dit M. Ritter, et il compte sur le concours de tous les Français attachés sincèrement à l'humanité et à leur pays pour lui aider à réaliser le problème *de la bonne eau partout.*

Les 40,000 Français qui meurent chaque année pour cette cause, doivent finalement être rayés de cette lugubre page annuelle de statistique, *il y va de l'honneur de la France.*

Sous ce rapport donc le milliard à employer pour résoudre ce beau projet, pourra tout en rapportant un bel intérêt être appelé le *millard bienfaisant.*

Eindringen von Unreinigkeiten in Druckwasserleitungen.

VON

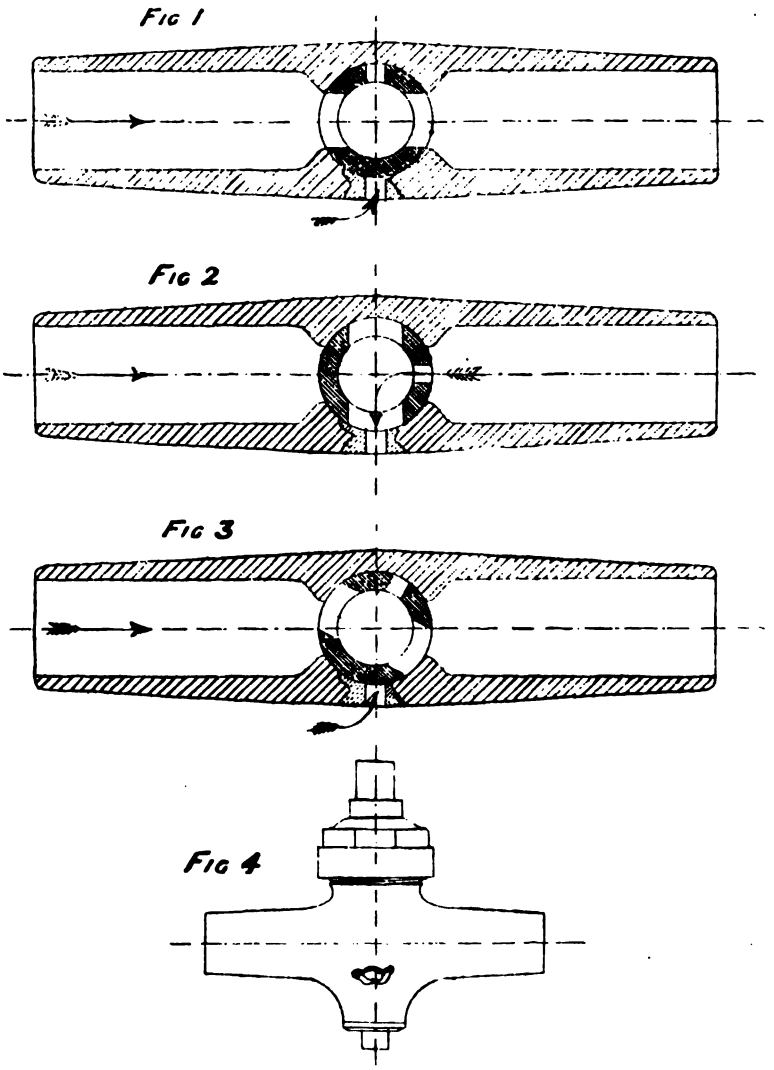
G. Oesten, Berlin.

Wenn man Wasserleitungsröhren mit innerem Druck in den Boden legt, so pflegt man nicht die Befürchtung zu hegen, dass Stoffe aus dem Boden in solche Röhren eindringen könnten, selbst wenn Oeffnungen in der Rohrwand entstehen. Man wird vielmehr überall die Vorstellung haben, dass, wenn in der Wandung eines gefüllten Wasserleitungsrohrs mit innerem Druck ein Loch entsteht, das Wasser unter allen Umständen mit der dem vorhandenen hydraulischen Druck entsprechenden Kraft ausströmen muss, indem es zugleich jedem fremden Körper den Eintritt verwehrt, und nicht annehmen, dass aus dem das Rohr umgebenden Boden Körper durch die Oeffnung in der Rohrwandung in das Rohr eintreten könnten

Dennoch kann dieser Fall eintreten und kommt in der Praxis der modernen Wasserversorgung vor. Hierzu sind natürlich besondere Umstände erforderlich. Diese können, wie eine einfache theoretische Erwägung lehrt, herbeigeführt werden durch die Art und Richtung des Rohrdefects und durch die Strömungsgeschwindigkeit im Wasserrohr.

Wenn in einem Wasserrohr die in nebenstehender Skizze durch Pfeil bezeichnete Strömungsrichtung besteht, so mag die Geschwindigkeit der Strömung gross oder gering sein, sofern nur das Wasserrohr unter innerem Druck steht; es wird sowohl durch eine Oeffnung in der

Wandung senkrecht zur Axe *a*, wie in stumpfem Winkel gegen die Strömungsrichtung *b* stets Wasser nach aussen austreten, ein Eindringen von Körpern nach innen nicht möglich sein. Anders stellt sich das Verhältniss, wenn der Leck die Richtung *c* spitzwinklich mit der Strömungsrichtung zeigt. In diesem Falle wird, wenn die Geschwindigkeit der Strömung eine geringe oder gleich Null ist, ebenfalls ein Ausspritzen von Wasser aus dem Leck stattfinden; mit der Steigerung der Geshwindigkeit des Wassers im Rohr wird das Entweichen von Wasser abnehmen. Bei einer gewissen Stromgeschwindigkeit wird nach dem Princip des Injectors eine saugende Wirkung des Wasserstrahls eintreten; derselbe wird dadurch fremde Körper in das Innere des Rohrs hineinziehen und mit fortführen.



In Wirklichkeit ist dieser Vorgang an dem in Fig. 1–4 abgebildeten Absperrhahn einer Hausleitung in Berlin beobachtet worden. Der Hahn ist ein sog. Absperrhahn mit Entleerung.

In Fig. 1 ist derselbe geöffnet dargestellt; die Entleerungsöffnung in Küken ist hier durch die Wandung des Gehäuses, die im Gehäuse durch das Küken verschlossen.

In Fig. 2 ist der Hahn geschlossen dargestellt; die hinter dem Hahn im Sinne der Strömungsrichtung gelegene Rohrstrecke entwässert sich bei dieser Stellung durch die Entleerungsöffnungen auf dem durch Pfeil angedeuteten Wege.

Fig. 3 stellt eine Mittelstellung des Hahns dar, in der derselbe in der Leitung vorgefunden wurde. Diese Stellung beförderte die Saugewirkung des entstandenen Lecks. Derselbe hatte sich hier als ein kleiner Kanal von der Entleerungsöffnung nach dem Innern des Hahns gebildet. Aus diesem Kanal war zunächst Wasser ausgespritzt und hatte die Entleerungsöffnung im Gehäuse ausgewaschen, wie in der Zeichnung zu ersehen ist. Alsdann aber war bei einer gewissen Strömungsgeschwindigkeit ein Ansaugen von aussen eingetreten und Sand in die Rohrleitung eingeschleppt worden. Dieser Sand lagerte sich wiederholt in den Zapfhähnen des Hauses so ab, dass diese unbrauchbar wurden. Als man dem Ursprunge des Sandes sorgfältig nachforschte, fand man die Ursache.

Es wurde nun das Einsaugen von Sand und gefärbter Flüssigkeit durch den im Hahn befindlichen Leck, sowohl in der Leitung, als auch nach der Herausnahme desselben in der Probiranstalt der städtischen Wasserwerke experimentell ausgeführt und festgestellt.

Aus Vorstehendem ergiebt sich somit die hygienisch nicht unwichtige Thatsache, dass eine Druckwasserleitung unter besonderen Umständen Unreinigkeiten aus ihrer Umgebung aufnehmen und mit dem Wasser fortleiten kann.

Thursday, 13th August 1891.

The Chair was occupied by
The President, Sir JOHN COODE, K.C.M.G.

The Present State of our Knowledge concerning the Self-Purification of Rivers.

BY

PERCY F. FRANKLAND, Ph.D., B.Sc. (Lond.), F.R.S., Professor of Chemistry in St. Andrew's University, Dundee.

There is, perhaps, no controversial matter connected with the hygiene of water-supply to which engineers have so frequently had their attention directed as that of the self-purification of river water. Although it is a subject on which most water engineers have a very decided opinion, the present occasion appears to me particularly favourable for reviewing the whole question by the light of the most recent information, especially as we have the benefit of the presence of a number of distinguished colleagues from abroad, whose opinions on this much vexed topic will be very welcome.

The subject of the self-purification of rivers admits of being considered from two perfectly distinct points of view, as indeed do almost all other questions relating to the purity of water, viz., from the chemical and the biological aspects.

Inasmuch as the organic impurities—and the controversy, of course, only refers to organic impurity—gaining access to rivers may be either devoid of life and unorganised, or living and organised, their discussion is in the one case a chemical, and in the other a biological question. Until recently the subject has been only considered from a chemical point of view in consequence of the impossibility which formerly existed of obtaining any precise or accurate information upon such matters of biology.

The firm conviction possessed by many that rivers undergo spontaneous purification in the course of their flow is generally based upon personal observations made upon streams in which the process appears to be going on in such a striking manner that no analytical evidence is required. All engineers are acquainted with streams which are visibly polluted at one spot, and apparently pure a few miles lower down. When such cases are further submitted to analytical tests, the latter, of course, fully confirm the previous ocular impressions. In fact, that such disappearance of organic matter does take place is beyond all shadow of a doubt, and it is mere waste of time to contest it. A bag full of feathers shaken into the air at one spot would similarly be imperceptible a few hundred yards away. That the polluting matter has been destroyed, however, in the course of a few miles flow is almost as improbable as that the feathers should have been decomposed in their short flight through the air. In fact, when these cases of supposed self-purification are carefully investigated, it becomes very doubtful

whether the phenomenon is due to anything beyond dilution and sedimentation. The careful experiments which have been made to test this point are by no means numerous.

A series of investigations was made by the Rivers Pollution Commissioners of 1868 to test the point, both as regards highly polluted streams, such as the Irwell, Mersey, and Darwen, and comparatively pure ones like the Thames; but in both cases their results were of a negative character, and pointed to no real purifications, *i.e.*, destruction of organic matter, although there was distinct evidence of considerable improvement in the quality of the water through sedimentation.

Some years ago, I undertook a series of experiments to further test this point in connection with the Thames, which has always been regarded by some as a river possessed of most remarkable self-purifying power, and which undoubtedly often does reach London after a long flow through a cultivated and fairly populated district, in a surprisingly pure state. The experiments in question consisted in taking samples of the water flowing in the river at different points on the same day, with a view to establishing whether on the whole the chemical quality of the water was improved or deteriorated during the course of its long flow. Thus, on one day, samples were taken at Oxford, Reading, Windsor, and Hampton; on another day at Chertsey and at Hampton; and on three different occasions samples were collected both at Windsor and at Hampton on the same day. The results of analysis of these various samples are recorded in the accompanying table, and clearly indicate that the chemical quality of the water undergoes slight but almost continuous deterioration in flowing from Oxford to Hampton. It must be remembered that this deterioration occurs in spite of a very large increase in the volume of the water, a large proportion of which gains access to the river from springs in the chalk and is of the very highest purity. Thus, Mr. Thornhill Harrison, C.E., has determined that the total increase in volume of the Thames between Maidenhead and Thames Ditton was (exclusive of the Colne, Wey, and Mole)—

In April, 1884	- 219,500,000	gallons per day.
On July 8th, 1884	- 49,000,000	„ „
July 22nd to 26th	- 131,000,000	„ „
November, 1890	- 45,000,000	„ „

(Harrison on Subterranean Chalk Water, Inst. Civil Engineers, 1891.)

In the above experiments I purposely limited the scope of my inquiry to the dissolved organic matter so as to avoid the complications arising from the suspended matters, concerning the removal of which by sedimentation there is no dispute. On this account all the above samples were filtered through Swedish paper before analysis. Indeed, it cannot be too strongly pointed out that unless the questions of dissolved and suspended matters are kept wholly distinct in these investigations, no reliance whatever can be placed upon the results.

From the analytical table it will be seen that the idea of any striking destruction of organic matter during the river's flow receives no sort of support from my experiments, the evidence is in fact wholly opposed to any such supposition.

TABLE I.—RESULTS of ANALYSIS expressed in parts per 100,000.

Description.	Total Solid Matters.	Organic Carbon.	Organic Nitrogen.	Ammonia.	Nitrogen as Nitrates and Nitrites.	Total Combined Nitrogen.	Chlorine.	Hardness. Temporary.	Hardness. Permanent.	Hardness. Total.
November 4th, 1883.										
River Thames, above Oxford	30·28	·136	·039	0	·178	·217	1·06	17·09	4·71	21·80
River Cherwell, 500 yards above Thames	36·92	·305	·079	·016	·164	·256	1·44	20·86	6·29	27·15
River Thames, below junction with Cherwell	33·04	·158	·036	·010	·197	·241	1·17	19·43	5·57	25·00
" " below Iffley lock	32·76	·165	·027	·002	·173	·202	1·20	19·16	5·14	24·30
" " below Oxford	31·04	·161	·031	·004	·190	·224	1·18	19·59	4·71	24·30
" " above Reading	33·32	·183	·025	·007	·255	·286	1·23	20·72	6·43	27·15
River Kennet, at junction with Thames	27·80	·128	·036	·008	·215	·257	1·26	19·44	4·86	24·30
" " at Reading	29·24	·125	·030	·014	·220	·262	1·26	21·13	4·57	25·70
" " " near drain-pipe	30·84	·256	·074	·023	·232	·325	1·60	19·73	4·57	24·30
River Thames, just above Windsor	31·80	·224	·038	·001	·219	·258	1·32	20·31	6·14	26·45
" " at Hampton	30·52	·254	·047	·001	·204	·252	1·43	16·99	5·86	22·85
November 17th, 1883.										
River Colne, branch in Staines	36·84	·318	·062	·019	·266	·344	1·45	23·7	3·4	27·1
" " main stream at junction with Thames	31·52	·236	·046	0	·254	·300	1·45	22·8	3·6	26·4
River Thames, above Staines gasworks	32·92	·242	·035	·003	·202	·239	1·33	20·1	5·6	25·7
" " just above Staines	32·40	·230	·036	·004	·194	·233	1·40	19·9	5·1	25·0
" " just below Staines	31·12	·245	·034	·001	·209	·244	1·36	20·8	4·9	25·7
January 2nd, 1884.										
River Wey, at Weybridge	20·44	·270	·065	·030	·223	·335	2·00	9·3	4·7	14·0
River Thames, at Chertsey	34·16	·187	·047	·014	·287	·346	1·45	20·3	4·2	24·5
" " " Hampton	31·92	·186	·035	·008	·281	·322	1·48	17·5	4·0	21·5
January 9th, 1884.										
River Thames, above Windsor	36·68	·197	·045	·005	·193	·240	1·47	20·3	4·2	24·5
" " at Hampton	34·88	·227	·067	·008	·229	·323	1·52	19·1	3·9	23·0
January 18th, 1884.										
River Thames, above Windsor	36·40	·291	·063	·010	·227	·298	1·50	18·8	5·7	24·5
" " at Hampton	33·56	·309	·055	·020	·226	·297	1·52	17·3	6·0	23·3
January 28th, 1884.										
River Thames, above Windsor	28·72	·478	·098	·014	·223	·332	1·7	13·6	6·4	20·0
" " at Hampton	29·76	·451	·082	·024	·222	·324	1·7	13·6	5·3	18·9
River Thames, above Windsor (average)	33·55	·275	·058	·008	·230	·295	1·49	18·66	5·33	23·99
" " at Hampton (average)	32·13	·285	·061	·012	·252	·304	1·53	16·90	5·01	21·91

TABLE II.—RESULTS of ANALYSIS expressed in parts per 100,000.

Description.	Total solid Matters.	Organic Carbon.	Organic Nitrogen.	Ammonia.	Nitrogen as Nitrates and Nitrites.	Total Combined Nitrogen.	Chlorine.	Hardness.			Number of Colonies obtained on cultivation of one cubic centimetre of Water.
								Temporary.	Permanent.	Total.	
No. 1.—Taken from River Ure, above Ripon, 27 miles above intake of York Waterworks. The River Ure rises on the western extremity of the North Riding of Yorkshire, passing on its way only small towns and villages	24·08	0·108	0·020	0	0·075	0·095	1·1	13·4	4·9	18·3	1,800
No. 2.—Collected about 16 miles above intake of York Waterworks, and about 3 miles below Boro'bridge, and 10 miles below Ripon, both discharging some sewage into the Ure - -	31·20	0·118	0·028	0	0·123	0·151	1·6	12·9	7·1	20·0	33,400
No. 3.—Collected from River Ouse opposite the intake of York Waterworks. Between the point of collection of No. 2 and this sample there is no town and only one small river, the Nidd -	28·40	0·123	0·025	0	0·077	0·102	1·6	11·5	7·1	18·6	31,200
No. 4.—Sample of water as supplied to York by the York Waterworks - -	26·20	0·119	0·022	0	0·089	0·111	1·6	10·9	7·1	18·0	122

I have also had an opportunity of making a somewhat similar experiment on the flow of the Ure and Ouse above York, the results of which are recorded in the preceeding table.

In this experiment also, there is not the slightest support to the theory of self-purification. Nor is there any diminution in the number of microbes during the observed flow.

Of foreign investigations on the same subject, there are those of *Hulwa* on the Oder at Breslau (Chemical News, 1883, 104; Biedermann's Centralblate für Agriculturchemie, XIII., Pt. I.), of *Frank* on the Spree at Berlin (Zeitschrift für Hygiene 1887, III., 355), and of *Prausnitz* on the Isar at Munich (Centralblate für Bakteriologie 1890, VII, 404).

Of these investigators, Hulwa professes to have traced the complete purification of the Oder from the sewage of Breslau after a flow of 32 kilometres. It is impossible to make any use of these results without a knowledge of the changes which the volume of water in the river undergoes during this flow.

A most complete account of the condition of the Spree during its flow from Berlin to Potsdam is given by Frank, full account being taken of the changes in volume during the course.

The results arrived at by Frank are, however, very different from those of Hulwa, for Frank maintains that the change in chemical composition is very insignificant throughout, but that the number of microbes undergoes a most striking diminution during the flow, a result which he naturally attributes to sedimentation. Already, in 1885, I had myself ("On the Removal of Micro-Organisms from Water," Proceedings, Royal Society 1885, No. 238) shown to what an astonishing extent micro-organisms are removed in the subsidence of solid particles; this I had proved, not only in the case of laboratory experiments made with the most varied materials, but also on the large scale in the softening of water by Clark's process. The disappearance of the microbes in the water of the Spree during its sluggish flow through the lake-like expansion which it forms after junction with the Havel at Spandau, above Potsdam, is obviously due to causes of a similar kind. In the experiments of Prausnitz on the Isar at Munich, there is the same disappearance of microbes during the flow, which is again attributed to sedimentation.

A careful study, therefore, of these most recent investigations leads us to the inevitable conclusion that sedimentation is the main cause of any self-purification in river water. Of any rapid oxidation of dissolved organic matter there is still no reliable evidence, although of course dilution, which frequently takes place on the largest scale, as in the case of the Thames, without being suspected until made the subject of a most careful scrutiny, will produce a superficial appearance of such a result.

This removal of microbes by sedimentation during the flow of a river is unquestionably of great hygienic importance, and of much greater hygienic importance than the alleged oxidation of dissolved organic matter, which in itself can have no power of communicating

zymotic disease; it is, however, a process which cannot be relied upon as furnishing any guarantee that harmful microbes, turned into a stream at a given point, will no longer be present in the water at any point lower down.

From the numerous experiments which have been made on the vitality of pathogenic microbes in water, there can be no doubt that many forms which might have subsided as above indicated, would remain alive for long periods of time, and be carried down uninjured when the river was next in flood. Indeed recent experiments of Lortet ("The Pathogenic Bacteria of the Mud of the Lake of Geneva," Centralblatt für Bakteriologie, IX., 709) have shown that such deposits formed in lakes actually, and not unfrequently, contain pathogenic forms in a state of vitality.

We must not allow, therefore, this sedimentation of microbes to cause us to relax our protective measures to exclude contamination from our streams; but on the contrary, bacteriological research clearly indicates on the one hand, the value and importance of purifying by the very best available means all dangerous liquids, such as sewage, before admission into rivers, and, on the other hand, the advantages to be secured by submitting the water drawn from streams for town supply to the most careful subsidence and filtration through sand before delivery.

Abkuhlung des Wassers durch Anlage von Kühlschächten.

VON

Professor A. OELWEIN, Vienna.

Im Jahre 1887 wurde mir die Aufforderung zu Theil, für die Stadt Iglau in Mähren, mit 23,000 Einwohnern, ein Wasserversorgungs-Projekt auszuarbeiten.

Die Stadt liegt 529·6 m. über dem Meere und hat eine mittlere Jahrestemperatur von 6°–7° C. Die Stadt und Umgebung gehört der Gneis-formation an, in der zwar aus einzelnen Mulden des Massifs, die mit Verwitterungs-Produkten ausgefüllt sind, kleine Quellen hervorbrechen, die aber zu einer genügenden Wasserversorgung bei Weitem nicht ausreichten.

Vor ca. 300 Jahren wurde in der Nähe von Iglau der Silberbergbau betrieben, und aus jener Zeit existiren heute noch in höherer Lage als die Stadt Teiche, die damals das Wasser zum Betriebe der Pochwerke sammelten, und aus denen die Stadt durch eine Holzrohrleitung auch Wasser bezog. Dieses Teichwasser erreichte jedoch im Sommer eine Temperatur bis 23° C., und nahm in Folge der Verwesungsprodukte, meist vegetabilischen Ursprungs, eine bräunliche Farbe und sehr üblen Geruch an. Die chemische und bacteriologische Analyse bezeichnete

dieses Teichwasser als ein zum Genusse und Gebrauche ***nicht brauchbares.***

Diese Teiche, vier an der Zahl, von 24·9 Hectaren Fläche, liegen, 3 Kilometer von der Stadt entfernt, terrasenartig übereinander. Der unterste Teich liegt 23 m. über dem höchsten Punkte der Stadt. Die grösste Tiefe derselben betrug nur 4·2 m. Sie fassten zusammen 483,000 m³, theils Niederschlags-, theils Quellwasser. Das Niederschlagsgebiet aller Teiche beträgt 368 Hectar, die mittlere Niederschlagshöhe im 10-jährigen Jahresdurchschnitt war 579·5 mm.

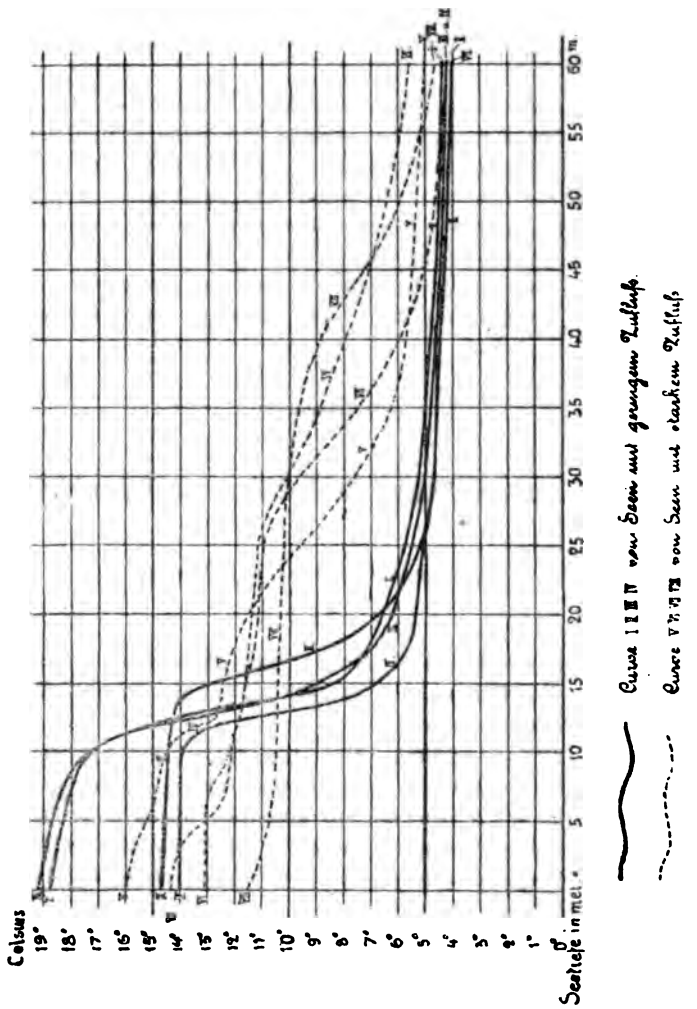


FIG. 1.—ABNAHME DER TEMPERATUR NACH DER TIEFE IN ALPENSEEN.

Da mir kein anderes Wasser zur Verfügung stand, entschloss ich mich, diese Teichwässer wieder zu verwenden, die Teiche zu reinigen und das Wasser zu filtriren. Diese Anlage ist seit Anfang 1888 im Betriebe und funktionirt gut. Das Wasser ist durch die Filtrirung

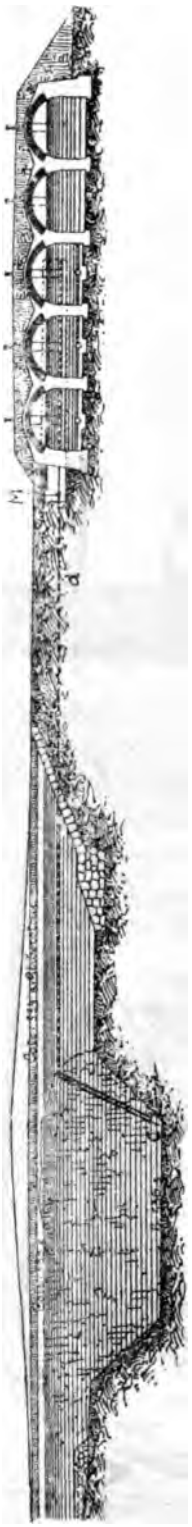


FIG. 2.—SCHNITT DURCH DEN KÜHLSCHACHT IN ABCDEF.

ganz rein geworden, und die chemischen und bacteriologischen Analysen erklären dasselbe für *ganz tadellos.*

Ueber die Filteranlagen, Reinwasserkammern, das Rohrnetz, etc. ist nichts neues mitzutheilen,—dagegen über die Anlage, die ich zur Kühlung des Wassers anwendete, und die sich sehr gut bewährt.

Professor Dr. Fr. Simony hatte 1879 einen Vortrag über die Art der Temperaturabnahme in Alpenseen gehalten. Aus den von ihm publizirten Ziffern, die ich in dem folgenden Graficon aufgetragen habe, ergab sich die interessante Schlussfolgerung, dass die Abnahme der Temperatur nach der Tiefe bei Seen mit geringem Zu- und Abfluss, die also ein wenig bewegtes Wasser haben, in einem ganz andern Verhältnisse erfolgt, als bei Seen mit starkem Zu- und Abfluss, also mit einem stark bewegten Wasser.

In ersteren Seen fällt die Temperatur von 10 m. Tiefe an rapid, erreicht ein Maximum bei ca. 20 m., um dann nur noch bis 60 m. Tiefe 2–3° C. abzunehmen. Ganz anders bei Seen mit stark bewegtem Wasser. Da nimmt die Temperatur bis 60 m. Tiefe allmälig und fast proportional mit der zunehmenden Wassertiefe ab.

Ich habe die gleiche Erscheinung noch bei vielen Messungen in Baugruben, Brunnen, tiefen Teichen und Seen constatiren können, dass bei wenig bewegtem Wasser die Temperaturabnahme im Sommer von 10–20 m. Tiefe eine plötzliche und relativ sehr grosse ist und entschloss mich, bei der Iglauer Wasserversorgung den praktischen Versuch zu machen, einen Schacht im untersten Teiche künstlich auszuheben, um das Wasser dann durch Röhren aus der Tiefe dieses Schachtes durch den hydrostatischen Druck der darüber befindlichen Wassersäule auf die Filter zu leiten.

Beifolgende Skizzen veranschaulichen die Anlage.

Dieser Schacht ist im Gneis gebrochen, und wurden die gewonnenen Steine zum Mauerwerk verwendet. Leider konnte der Schacht aus finanziellen Gründen nur eine Tiefe von 17·3 m. unter dem höchsten Wasserspiegel erhalten; der Erfolg dieses

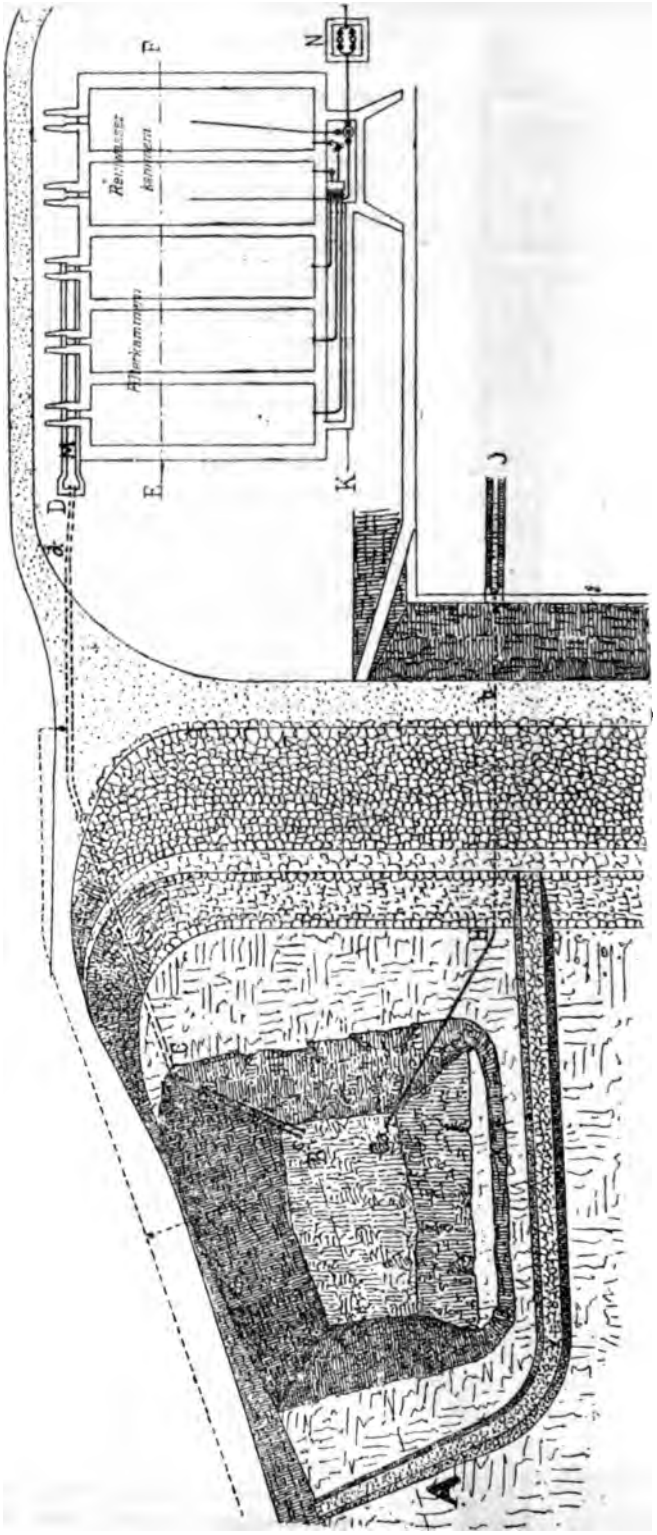


FIG. 3.—SITUATION DES KÜHLSCHACHTES.

Kühlschachtes hat aber trotzdem die Voraussetzung vollkommen bestätigt.

Der Kühlschacht fasst bis zur Teichsohle eine Cubatur von rund 9,000 m.³ Der Wasserverbrauch wechselt Winter und Sommer von 600-800 m.³ per Tag und steigt zeitweise bis 1,000 m.³

Seit 1888 ergaben sich fast unverändert die gleichen Resultate.

In dem folgenden Graficon sind die im Jahre 1888 beobachteten Temperaturen des Wassers im Teiche, 1 m. unter dem Wasserspiegel gemessen, und des aus der Tiefe des Kühlschachtes aufsteigenden Wassers ersichtlich gemacht. Die folgenden Jahre geben ein ganz analoges Bild.

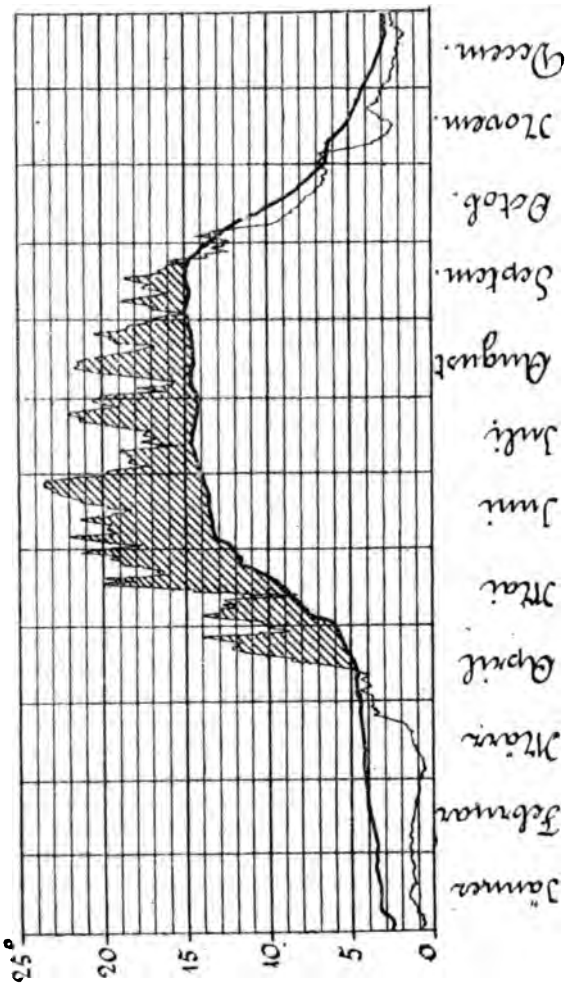


FIG. 4.—TEMPERATUR-DIFFERENZEN IN GRADEN CELSIUS.

Die grösste Temperatur-Differenz tritt im Hochsommer ein, wenn die Teichwässer die Temperatur von 20° C. überschreiten, und zwar bis zu 9·6° C. Die grösste Differenz wurde mit 10·5° C. bei einer Teichwasser-Temperatur von 22° C. beobachtet.

Ich bedauere nur, dass der Kühlschacht nicht mindestens eine Tiefe von 20 m. erhalten konnte, da ich überzeugt bin, dass diese Differenz dann noch um 2–3° C. grösser gewesen wäre.

Der Ingenieur kommt oft in die Lage, im Tieflande Teiche und Thalsperren zu Zwecken der Wasserversorgung verwenden zu müssen, denen er keine grössere Wassertiefe geben kann, als 4-5 m. Dann hat er es im Sommer stets mit sehr erwärmtem Wasser zu thun. Hier ist ein Mittel ohne grosse Kosten gegeben, dieses Wasser auf natürlichem Wege zu kühlen. Deshalb glaubte ich auch, dass die von mir angewendete Methode viele meiner Collegen interessiren wird.

Um etwa dem Einwurfe zu begegnen, dass diese Abkühlung eine Wirkung der Filter ist, füge ich noch an, dass ich im Hochsommer das erwärmte Teichwasser direkt auf die Filter leitete, dieses Wasser aber dann nur um 1·5-2° C. abgekühlt wurde, die Wirkung des Kühlschachter daher zweifellos ist.

DISCUSSION.

Professor Henry Robinson said he wished to render his meed of thanks to Dr. Frankland for the very important paper he had communicated to the section. As part of the subject of water-supply, the hygienic properties of water was a question of enormous interest to all engineers. The matter had been referred to already in the paper which he read on Tuesday, in which members would remember he called attention to some of the points so ably brought before them by Dr. Frankland. There was one question he wished to ask. Dr. Frankland, in giving the conclusions he arrived at with regard to the River Thames, said, that so far from the water improving between Oxford and Hampton it had become deteriorated, a statement which was quite at variance with the theory that a rill of water purified itself in its flow. The very important consideration arose as to whether the water passing at the various points at which specimens were taken was the same water and under the same conditions. To put it in another way, supposing they had a polluted water at one point and no possible source of further pollution between that point and a point three miles lower down, was it the fact that in the passage of the water through that three miles of distance the self-purifying action upon which they had relied so much did not take place? This was a most material point for consideration. They knew that between Oxford and Hampton there were conditions applying to the river which would quite account for the water deterioration. He mentioned this with a view of eliciting from Dr. Frankland whether he had or had not taken that into account in coming to the very strong conclusion as to the incorrectness of the view they had held up till now, that for various reasons with which they were all familiar, a river would in the course of its flow purify itself to a very great extent. That was the view engineers had held up till now, and he ventured to think that unless they had some strong proof that the condition of things which Dr. Frankland had referred to was at variance with that view, he should keep an open mind upon the subject.

Mr. Baldwin Latham said Dr. Odling had put this matter very tersely when, in a discussion on the previous day, he said that the diseased germs were ultimately destroyed when they went into flowing water, and that the only question which arose was as to the destructibility and regeneration of the spores of those germs. With regard to Dr. Frankland's experiments, he wished to draw attention to this very remarkable fact, that the analyses did not represent the same water. They were taken simultaneously throughout the river, and, as it took several days for the water to flow from Oxford to London, it was utterly impossible for the analyses which had been given to be analyses of the same water; and until they got results dealing with absolutely the same water, it was quite futile to say no purification took place in a river. The State Board of Health of Massachusetts had recently made a most elaborate investigation of all the rivers in their district, and they had taken into consideration, by gauging, the increase of the volume of all those rivers in the most careful manner. The conclusion they had come to was that there was a considerable degree of this self-purification taking place after all these other contingencies had been taken into account. With regard to the sedimentation, of course, if matters subside in the bed of a stream, when a flood comes they are washed out, and the result should be shown in the analysis. The most extraordinary thing with reference to the Thames floods was this, that whenever the Thames got into excessive flood, certain classes of chemists universally condemned the water-supply. The last great floods of the Thames were in January 1877, and during that time, week after week, while the chemists were telling them that the London water-supply was totally unfit for all dietetic purposes, the Registrar General was reporting "the health of London has never been surpassed; all classes of disease "are a long way below the average." Those two things occurred in the same reports when the Thames was in flood, and therefore, although it might show that there was an increase in the organic and other impurities in water, it did not show that the water had been rendered unwholesome or unfit for the people to drink. There was another important point with regard to cholera and the germs which pass into rivers; it had never been shown that cholera passed down a river, but on the contrary it universally passed up the rivers. This was most clearly shown in the case of the last epidemic of cholera in Egypt, where there was not a single case recorded as occurring in the higher parts of the river until it had been first developed in the lower part of the Nile. And so it occurred in other districts, showing that the impurities were not conveyed by the water, but were carried by human intercourse, as a rule, up the valleys of the rivers. With regard to the biological aspects of the water question, it appeared to be the fashion, if a multitude of these little microbes were found in a water, to suppose that that water was injurious. There had been a great deal of discussion in recent years about the friendly microbe. They knew that there was an organism which had the power of altering nitrogenous matter called the nitrifying organism. The subject had been more fully worked out since by Professor Warrington and Messrs. Lawes and Gilbert, and it had been conclusively shown that that nitrifying organism existed in water, and that it had the power of destroying to a great extent all those matters which had hitherto been looked upon as injurious. A certain amount of nitrogenous matter must be necessary for the existence of these friendly microbes, and therefore the presence of a certain amount of nitrogenous matter might have a direct beneficial effect in providing food

for those organisms which probably were the destroyers of those other organisms which were so destructive to human life.

Mr. Church said that in the papers read yesterday, and also in that read by Dr. Frankland, the question seemed to have arisen whether rivers purify themselves throughout their course, or whether the contrary was the fact. He might, perhaps, give a somewhat important instance on a grand scale of the purfying or non-purifying effect of a great river. He alluded to the upper valley of the Madeira River in the Amazon, with which he was very familiar. That had an area of some 200,000 square miles above the falls of the Madeira. Perhaps 3,000 miles of smaller rivers concentrate at the head of a series of falls, cataracts, and rapids, which for 300 miles continued along the course of the Madeira River. That upper valley, during about three months of the year, was largely flooded to a depth of from two to three feet, or, perhaps, from one to four feet over 40,000 or 50,000 square miles. When the rains commenced to raise the river waters and flood the country they naturally washed off the vast area, and all the sediment and organic matter were concentrated upon the head of the falls. That was the most unhealthy period along the line of the falls, and it continued perhaps for a month or six weeks. Then, while the rivers were high, and the floods existed over the land, it became more healthy. Afterwards, when the floods subsided and the land appeared again, there came another very unhealthy period; and again, in the dry season, it might be said that the country was very healthy. It was notable in that stretch of 300 miles of river which was broken by cataracts and rapids, that at each fall it was very unhealthy; the intermediate stretches of the river were comparatively healthy; and he had noticed that it grew more and more unhealthy as they descended the river, until they reached the last fall of San Antonio, which was almost pestilential. That would seem to carry out the theory that the river did not become more purified as it descended. There might, however, be some reason for this other than the mere flow of the water, viz.: that the main ridge of mountains which ran across Brazil stopped at the falls of the Madeira, and impeded the winds which went up the Amazon from purifying the air at that point. This also was, perhaps, interesting with regard to malaria. From certain observations he had made in the Amazon Valley with regard to malaria, he did not always find that a swamp was more unhealthy than high land; on the contrary, some swamps were more healthy than the high grounds. Then again, if they took 50 acres of ground, felled the trees, and burnt the vegetation, in the course of two or three years a very unhealthy spot might become very healthy; but, strange to say, a period of two or three years might afterwards occur during which it went back to its old unhealthy condition. With regard to the sediment in these waters, the Madeira had affluents which contained a great deal, but it also received some clear-water rivers, notably that which formed the boundary line between Bolivia and Brazil. That river was almost as clear as crystal, but all the Indians and the savages there avoided drinking its waters if they possibly could, preferring the turbid waters of the other rivers. He had noticed that fact also in his own country, in the Western part of the United States on the Missouri River. At Council Bluffs, in ordinary normal times two gallons of water would deposit a pint of sediment, and yet it was considered much healthier than the clear waters of some streams that flowed into it.

Herr W. Kümmel (Hamburg) drew attention to a series of experiments made in two places in Germany on the same subject as that dealt with in Professor Frankland's paper. The first related to an examination made by the Imperial Board of Health in Mecklenburg, as to the condition of a small river; and the second, to experiments made by chemists of the town of Frankfort-on-the-Maine. The Board of Health of Mecklenburg were invited to make experiments with the water of the River Nebel, because the town of Rostock made complaints against the town of Gustrow that they were polluting the river with sewage water. The town of Rostock took its water-supply from the Warnow. The Nebel runs into the Warnow, and the town of Rostock said their water was polluted by the sewage water of the City of Gustrow. The Imperial Board of Health sent a committee to investigate this matter, including an eminent biologist, and these gentlemen made a trip up the Nebel and Warnow from Rostock to Gustrow, a distance of about 80 kilometres. They tested the water at various places from above the town of Gustrow down to the Rostock waterworks. They found that, though the town of Gustrow deteriorated the water very much, and that the water two kilometres below was deteriorated much more by a large sugar manufactory, the number of microbes above the town of Gustrow and that 25 kilometres below the town, and below the sugar manufactory, was nearly the same; that whilst in the interval the number of microbes had increased to 48,000 in a cubic centimetre, the number was again reduced to about 200; and at last, just above Rostock, where the river was said to have been deteriorated by the sewage of the town above, the number of microbes was less than it was above the town of Gustrow, and no town at all was situated above the point where the first test of the water was taken. This experiment was made twice, once during the summer and the second time in October last. The result of the inquiry had been that the Imperial Board had declared the town of Gustrow might send its sewage water into the river. A subsiding reservoir would be made 300 metres in length, and the effluent run off into the river. The account of the second series of experiments in Hamburg and in Frankfort, was published in the last number of the "Deutschen zeitschrift des Vereins für offentlishe Gesand heitspflege." He was sure Professor Frankland could not have read that paper, because it was only published last week. The result of the experiment in Frankfort showed that there was no difference at all in the number of microbes, although the sewage-water was passed through very long subsidence reservoirs; that the number of microbes remained absolutely the same, whether the sewage water had been treated with lime or not. The conclusion arrived at was, that the only way to purify sewage-water was to precipitate all the things which were suspended in the water, and for this purpose a very slow flow and a long subsiding reservoir answered best. This was nearly the same result as that arrived at by Professor Frankland.

Mr. A. Mault said he agreed with Mr. Baldwin Latham, that from an engineering point of view the experiments conducted by Dr. Frankland were hardly satisfactory for proving the conclusions to which he appeared to have arrived; it being evident that the same or similar water was not analysed down the course of the River Thames. To arrive at any satisfactory result it would have been desirable to take the water at Oxford, and again before any further great source of pollution, such as at Reading, had been passed, and to have noticed what had taken place in the water as it went down from one great source of pollution to another.

There would have been no great difficulty in doing that because, as Dr. Frankland had pointed out, there were sources, perhaps, not of purification exactly, but of dilution that were continually entering the Thames. He seemed to make a point that, notwithstanding those sources of dilution, the water was chemically getting worse and worse; that was, the water as tested at points greatly distant one from another; but he (Mr. Mault) felt certain that although these sources of dilution were very considerable, the sources of pollution that were passed increased in a greater ratio even than the sources of dilution. Another point he should like to get a little information upon was as to the ultimate result of purification by sedimentation; were the organisms, whether in a state of perfect vitality and activity, or in a state of spores, finally got rid of by being deposited? As Mr. Baldwin Latham said, to some extent, certainly, they were brought on again in the case of floods; but he could not help thinking, from an ordinary common-sense consideration of the thing, that something else must be continually taking place; also that the beds of sediment must to a certain extent become nurseries and breeding places for the supply of organisms lower down. He did not know, without further consideration, how the matter could be tested as to what effect these sedimentary beds had on the quality of the water lower down the river. That was a point on which it was exceedingly desirable that some information should be obtained if possible.

Dr. Solomon Smith (Halifax) said there were two diametrically opposed propositions before the meeting, both supported by experiment and observations. It seemed obvious that there must be an error in one or the other series of experiments, or in their interpretation; and he confessed to the belief that the error was on the side of the interpretation. The result of Dr. Frankland's experiment and investigation was that there was, as regards the soluble material in the river, a slight deterioration as the river progressed; but that all the time the water was charged with a slowly soluble material. If it were not the case that during the flow a gradual purification was constantly taking place, the later observations at the lower part of the river would show a very much worse result than it did; but the fact was that, coincidently with the process of purification, a process was also going on of fouling by the gradual solution of the slowly soluble materials which were flowing down the stream. That had not been pointed out, and his sole reason for rising was to point out that it was a constant and necessary source of error. If the water was carrying down unsedimented slowly soluble material, which it certainly was; and if all the time that material was being dissolved and tending to make the water foul; and, if at the end of its course it was only slightly fouler than it was before; he believed that in the course of its flow, although the ultimate result was a slight increase of foulness, there had been going on a continuous process of purification to prevent it becoming very much more foul than it had ultimately become.

Mr. Anderson (Bremen) said he wished to place a few facts before the Section. The first was, that at Bremen there was a large stretch of mud which had always been offensive during hot weather as long as he had known it. Whether it was still so he could not tell, as he had not been there for seven years. The second fact was an observation he made in Berne, and possibly the delegate from Berne could explain it. On the River Aar, flowing round Berne to the western side, there was a slaughter-house, and from that slaughter-house the blood ran into the

Aar. Going a little further down the river, all traces of the blood seemed to be lost, and the water looked as fresh and sparkling as champagne. He suggested whether the fish life and plant life had something to do with the purification. He wished also to mention another thing which he had seen under the guidance of Professor Faraday, who showed him how water could be kept pure without any foulness whatever by keeping the plant life and the animal life in balance; that the water in an aquarium need not be changed at all by keeping these in proper balance.

Mr. J. R. Morse asked whether boiling the water destroyed the microbes, or whether they would resist its action? It had been his habit for many years to boil all the water used in his house first, and then filter it afterwards. That appeared to be a prudent course.

M. Maignen, in reply to a question asked by Mr. Anderson, said it was a case of the survival of the fittest, and when there was no more to eat the survivor died himself. That was to say, if they put vegetable matter or animal matter in water and let it alone, fermentation would take place. The time came when the fermentation was finished for want of material. It was the old story. Ships took water from the Thames, and, after a time the water became putrid, and then after a time it was again perfectly sweet. With regard to boiling water, he had in his hand a pamphlet which appeared two months ago in Paris, and these were the exact figures given as to the effect of boiling upon bacteria. If the water was kept for 10 minutes at 130° cent. the water was perfectly satisfactory; but if it only remained five minutes it was not. At 120° it required 15 minutes; and at 10 minutes it was not satisfactory. Therefore, for destroying bacteria, they required to have a closed vessel and to keep the water at 130° cent. for at least 10 minutes.

Dr. Percy F. Frankland in reply, said he felt some hesitation in bringing this paper before the section, inasmuch as it was a subject of considerable antiquity, but it was also a subject on which there was still a very large amount of light required. He very much regretted not having heard Professor Robinson's paper, but he gathered from his remarks, that he was on the whole entirely in accord with what he (Dr. Frankland) had said. The only point on which he apparently differed, was that he considered they had not adequately taken into consideration those pollutions which entered the river between Oxford and London The same point had been raised by other speakers, and it was contended that the mode of experiment, was not a satisfactory one. Of course it was very easy to pick holes in a method of experiment, but it was not so easy to suggest better ones; and he observed that not one of the speakers had indicated a method of examining Thames water which had anything to recommend it in preference to his own. It was absolutely impossible, practically, to take a stream and examine the same water at two different points. There was hardly any stream to be found in which either the volume was not increased, or fresh pollution had not come into it along its course. Some method of compromise had therefore to be adopted, and he believed the method he had employed was as satisfactory a one as could be found. He examined the water at different points, on the same day, and repeating those experiments on a number of different days he took the mean of the results, so that it might fairly be said that the figures obtained represented the relative quantities of impurity in the river at different points along its course. As a matter of fact, the pollutions which entered the Thames came principally along the tributaries,

and those tributary streams were themselves already polluted to a certain extent. He might point out that there was no very striking pollution of the River Thames all the way down. The River Thames was one of the best protected streams that could possibly be found, and the work of the Conservancy had improved it enormously within the memory of even the youngest amongst them. The tributaries, although some of them were slightly more polluted than the river, were only very slightly so; so that each of the pollutions entering the Thames between Oxford and London brought with it a corresponding quantity of water, or very nearly so. In addition, however, to these pollutions which came in along with a corresponding quantity of water, and therefore not perhaps interfering with the general quality of the stream, they had an enormous volume of water, as the experiments of Mr. Thornhill Harrison conclusively proved, of the very purest character that it was possible to find upon earth, namely, the spring-water from the chalk beds over which the river flowed in many parts. There was a point raised by Mr. Baldwin Latham which he could not allow to pass without an observation, and that was as to the ultimate fate of pathogenic organisms which might enter the river. Mr. Baldwin Latham referred to a statement made by Dr. Odling in a previous discussion. He (Dr. Frankland) unfortunately had not the opportunity of hearing what Dr. Odling said, but he might surmise what he did say, being acquainted with the experiments upon which he would base his remark. Those experiments were made by Professor Odling, Mr. Crookes, and Dr. Tidy, some years ago on the effect of introducing the bacilli of anthrax, a well-known disease caused by micro-organisms of a particular kind, into water. They found that these bacilli of anthrax underwent very rapid destruction in water. Performing a perfectly similar experiment he had himself obtained a similar result, but with one point of difference. The bacilli of anthrax, as every novice in the study of bacteriology knew, were capable of producing spores. Those spores, or eggs as they might be called, were possessed of enormously greater powers of endurance than the parents which produced them. It ought never to be forgotten that in the experiments of Messrs. Odling, Crookes, and Tidy, the organisms employed were carefully prepared so as to have no spores in them. They could always obtain anthrax organisms free from spores by taking these organisms from animals which had been killed by anthrax. Anthrax produced no spores in the animal body. In the experiments of Messrs. Crookes, Odling, and Tidy the anthrax bacilli used were obtained from animals that had been killed by anthrax, and therefore these organisms, were destitute of spores. In the same way he had introduced anthrax bacilli into water and had found that they were rapidly destroyed; but with spores the thing was utterly different. The spores would last weeks or months, and that was a point which had been confirmed by numerous other investigators; so that it would be very undesirable if the meeting went away with the idea that these pathogenic organisms were rapidly destroyed in water. Mr. Baldwin Latham had spoken also about friendly organisms, and had referred to a particular organism which was a special friend of his (Dr. Frankland's), viz., the nitrifying organism, for which he had a particular feeling of interest, inasmuch as it was discovered by himself. Although he had a great affection for this nitrifying organism, he was bound to say that, at present, there was absolutely no evidence whatsoever that it was destructive of other organisms. In fact, the conditions under which it lived were totally different from those of other ordinary organisms; for, whereas pathogenic

bacteria in most cases required a certain amount of organic matter, often very highly concentrated, for their propagation and growth, this nitrifying organism grew by preference in liquids absolutely destitute of organic matter; in fact they only got nitrification taking place where the liquid was practically free from organic substances. He was afraid, therefore, they could not rely upon this very important organism for effecting the destruction of pathogenic forms. As to the movements of cholera epidemics up rivers and not down rivers, although there were cases of that kind, one would be very much surprised if that was not the general course of events when it was remembered that cholera was almost invariably introduced at sea ports, and, of course, found its way into the interior only by transmission along railway lines, and so on. He believed Mr. Baldwin Latham did not wish it to be inferred that cholera travelled up the river-water like a fish swimming against the stream. He would find, on reference to some recent statistics of investigations made by the Indian Medical Department, that cholera did travel down rivers, and there were numerous cases where it had been obviously introduced into rivers above, and people had taken it lower down. Herr Kümmel, of Hamburg, had referred to the pollution of a river in Mecklenburg above the point whence the water supply to Rostock was to be drawn. He had listened to Herr Kümmel's remarks with great interest, but they did not induce him to alter his opinion; and indeed the opinion of all English sanitarians was that it was highly undesirable, whatever the truth might be about the purification of rivers, to admit sewage into a stream at such a short distance, or, in fact, at any distance above that at which a water-supply was taken. They could only learn with great regret that the Imperial Board of Health of Germany should have recommended such a step. The Conservancy Boards, and the Local Goverment Board of this country would never tolerate the admission of sewage into a stream above a point at which water was taken for town supply. There were, of course, in this country a great many cases where water-supplies were being taken, and had been taken for a long period of time, from the river below the points at which sewage gained access. It had been the business of their Local Government Board and Conservancy Boards to diminish that pollution as far as possible, but they would never allow a new case of that kind to arise. It had been remarked that these beds of subsided organisms and subsided organic matter might be the cause of danger afterwards. As he had pointed out, there was no question whatever about the sedimentation of matter, living and dead, taking place in rivers, especially in sluggish rivers. As he also indicated, there was, however, no evidence that the organisms which subsided in that way were destroyed, and consequently the greatest apprehension must always be felt when floods stirred up these things and carried them further on. He, in fact, distinctly referred to some very careful recent researches by two French investigators on the mud of the Lake of Geneva. The Lake of Geneva caught nearly all the suspended matter in the Rhone, and the mud of that beautiful lake had been found to contain numerous pathogenic organisms which were not destroyed by their long residence at the bottom of the lake. He had no intention of saying that there was no purification taking place, even of dissolved matter. Far from it; he entirely belived that there was a certain amount of purification, even in the case of dissolved matter, taking place, but it was not of that sweeping character generally thought to be the case. There was no evidence of that very rapid oxidation or removal of dissolved organic matter. Finally he came to the question of the boiling of water;

and here he should like to point out that they were dealing with an entirely different question. It was extremely difficult to trace the process going on in rivers, but it was very easy to determine what took place when they were boiling water in a kettle, a flask, or anything of the kind, or in laboratory experiments, in which any careful investigator could easily obtain accurate results. It could not be too widely known that the mere boiling of water in a kettle was almost an absolute guarantee against zymotic disease which might be conveyed by drinking water. He very much regretted that those French figures were brought up. All bacteriologists knew that there were forms which were not destroyed, but they could not have a simpler and more perfect method of defending themselves from infection by contaminated drinking water, than by boiling that water. Although it might be true that a few forms did remain alive under exceptional circumstances, there could be no doubt that the simple process of boiling was an almost absolute safeguard against the communication of zymotic disease. There was, however, another channel, and he must just mention it, though it was, perhaps, irrelevant to the present discussion. It was the general belief that far more zymotic disease was communicated by means of milk. The boiling of milk was an operation of even still greater importance than the boiling of water.

The President said he was not very fond of making comparisons, but he could not help feeling that there was probably no subject and no discussion which would take place during that Congress which would contribute, he would not say as much, but would contribute more to the public health than that which had engrossed their attention that morning. He was exceedingly glad to see that they had so full an attendance, and they might congratulate themselves that the subject had been so ably dealt with by the reader of the paper, and by the different speakers.

The Refuse Destructor.

BY

CHARLES JONES, M. Inst. C.E., F.S.I., Engineer to the Ealing Local Board.

Before dealing with the special subject of this paper, although the time is too short to treat it in anything like an exhaustive manner, I must briefly call attention to the material with which we have to deal, viz., "house and town refuse."

For many years the disposal of this material has occupied the attention of sanitary engineers, surveyors, town councils, and other public bodies, and of many indirectly connected with the sanitary well-being of the country; but so long as there was a vent in the way of brickfields for the breeze, and spare ground for the "soft hardcore," little or no difficulty was experienced. During the last 10 or 15 years these modes of disposal have been generally decreasing. Brickfields have been removed from the neighbourhood of towns, and the growth of sanitary

science has put a veto upon the filling up of waste sites with garbage and refuse. In the days of the "Golden Dustman," large sums were paid for the privilege of removing the material. At the present time, great difficulty is experienced and large sums spent in getting rid of what was once considered valuable matter, notwithstanding that it might be said to consist of the contents of ashpits, market-refuse, the sweepings of paved streets, and an heterogenous mass of indescribable material which forms the débris of every establishment and of every town.

Some 20 years ago Paddington was the favoured depôt for this matter, carted principally from the western districts; and the writer of this paper has still an odoriferous recollection of the condition of one of the best conducted of these establishments, having had to arrange, some 14 years since, for an installation of electric lighting in order to keep the place going at night as well as by day. Perhaps nothing more striking can be given than the description of Dr. W. S. Saunders, medical officer of the City of London. He says: "When the dust carts arrive "at the wharf (Lett's), their contents are tipped into heaps at the place "most convenient for the people who are employed as sorters. About "70 persons, chiefly women, were engaged in this degrading and "loathsome work, most of whom are paid by piece-work, but 16 female "sifters received 7*s*. and a little coal and wood weekly. The appearance "of these women is most deplorable, standing in the midst of fine dust "piled up to their waists, with faces and upper extremities begrimed "with black filth, and surrounded by and breathing a foul, moist, hot "air, surcharged with the gaseous evacuations of disintegrating organic "compounds. . . . . I shall not forget visiting some of these "poor creatures in a hospital, and witnessing the condition of their skins "when the accident to the chimney shaft occurred." Happily this description is one of the past, but probably the City of London can even now give the best illustration that I can place before you, and from late reports it is evident that some other method will have to be found to rectify this still existing nuisance.

Perhaps the greatest difficulty which the sanitarian has to contend with is the strange idea which possesses the mind of the economical ratepayer, that something is still to be made out of this and other material with which the Corporations have to deal; but the man who boasts that he is going on the Local Board or Council in order to economise the taxes of the people in this way soon finds how hopeless is the task he has undertaken, so far as the treatment of town-refuse is concerned. So far as I can gather, the quantity to be dealt with in London alone, *i.e.*, that portion which comes under the control of the London County Council, is some two and a half millions of tons per annum, more rather than less. This quantity is gathered from the several large London districts. I will simply cite three of the most important, by way of illustrating the different modes of dealing with this subject, viz., Kensington, a western district, Hampstead, N.W., and Camberwell, S.E.

For the year ended 31st March 1891, Kensington disposed of 44,549 loads (23 cwt. to a load). (It will be remembered that the

Kensington Vestry was defeated in the House of Commons in its attempt to deal with the refuse in a scientific manner.) Half of this material is barged away from the parish to Purfleet, where the Board have acquired 17 acres of land; and before very long they will undoubtedly be compelled to deal with the question in some other mode than in forming a mountain of garbage on the banks of the Thames. The cost is 1*s.* 11*d.* per load for barging. The other moiety is barged by contract to some point on the Grand Junction Canal, at a cost of 2*s.* 6*d.* per ton. I do not know the neighbourhood in which the shoot is situate, and if I did know I should not like to tell you; but I have no doubt the inhabitants of that neighbourhood will before long find their legal remedy, as we have had to do at Ealing. The entire cost of the collection and distribution of these 44,549 loads is just about 8*s.* per load, and amounts to a very large item in the accounts of the parish of Kensington.

Hampstead, during the 12 months ending 1890, disposed of 18,441 tons. They have been wise in their day and generation, and have provided a proper mode of dealing with the difficulty with a more satisfactory result in the figures of the local board finances; the cost amounting to not more than 6*s.* 1*d.* per ton, or 25 per cent. less than Kensington.

The last-named district, on the S.E. of the Council's boundary (Camberwell) during 1890 had to dispose of 31,321 loads (24 to 25 cwt. per load) of refuse. Of this quantity, 16,492 was removed by barge (contract), and we are led to suppose that the greater quantity is used in brickfields. Of the other portion, 10,181 loads are delivered at special and other shoots in various parts of the parish at agreed prices, to form probably at no distant date (unless care is exercised and a record kept) foundations for eligible suburban villas; and 4,640 loads are sent away by rail. The cost of this is 2*s.* 3*d.* per dust-load for the first three months of the year, and 2*s.* 8*d.* per load for the remainder of the year, this of course being additional to the cost of daily collection.

It must be borne in mind that the figures which I give grow at an enormous rate; for instance, in Kensington, in the year 1882, a total of 29,922 loads were disposed of, and in 1891, 44,549 loads.

Turn for one moment from London and its surroundings to the second important town in the kingdom, viz., Liverpool. The number of loads (of one ton) dealt with in 1890 was 249,290; of this quantity 156,299 tons were taken out to sea, and we have heard that not a little of this material, like Jonah of old, was subsequently thrown up on dry land. The remaining 92,991 loads were sold to farmers and others. The cost averages much less than in London, being 1*s.* 11*d.* per ton. I am happy to state that, at last, Liverpool has started in the right direction, and is now engaged in erecting a sufficient set of destructors to deal with this troublesome question.

From returns lately issued, out of 93 towns from which particulars have been obtained, 37 (many of large population) dispose of their refuse by carting to shoots, or other less objectionable modes of disposal. The

remaining towns utilize or adopt, in some way or other, the principles of the destructor.

In the foregoing remarks I have endeavoured to lead the way to the consideration of the best means of dealing with town and house refuse, viz., by the proper use of the "refuse destructor."

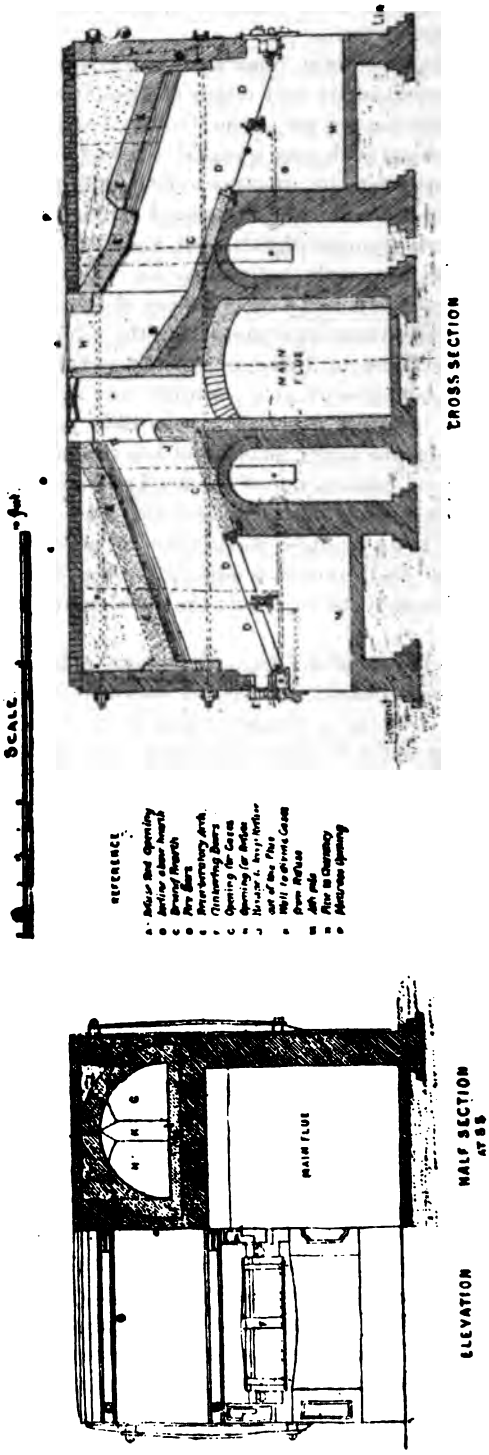
Looking back over a period of something like 30 years, we find that many have been the attempts to deal with this question of house-refuse in a more scientific and economical manner, and the difficulties surrounding it have occupied the thought and attention of inventors for many years. It was only natural to fall back upon the greatest agent of purification, fire, and a short history of the various appliances in the way of furnaces invented for destroying the refuse by means of fire will be of interest. Most of these were built either by contractors, or by those who did not consider, in a scientific way at any rate, the action of heat and how to utilize the small combustible portion contained in refuse for burning up the larger quantity of less combustible material. The shape and general construction of the fire-brick arches were wrong, the arrangements for feeding were bad, and the flues and passages for gases were designed more by guess-work than by calculation. In short, they were but feeble and crude attempts to utilize the agency of fire, and were used, ultimately, to burn only the more combustible portion of the refuse collected.

Mr. Fryer (of the firm of Manlove, Alliott, and Fryer), after several years of experiments, induced his own corporation, that of Nottingham, to give a trial to a furnace which he had made, and which he called "the Destructor." The trial turned out successful, and in a very short time three large destructors were built upon Fryer's patent.

I will here explain, for the benefit of those who may not be familiar with the construction of the apparatus, the drawing (kindly lent by Messrs. Manlove and Co.). The cells are constructed as represented in the diagram, which shows the internal arrangements of the flues, feeding hoppers, furnace doors, and firebars; or the cells may be built side by side, as at Ealing. The disposition of the cells, either one way or the other, is simply a matter dependent upon the site and the convenience of the situation. It will be seen that each cell constitutes a separate furnace, consisting of a cavity enclosed by a reverberatory arch lined with fire-bricks. It is supplied with a hearth for the reception of the material to be consumed, from which it passes to the furnace proper. The firebars are placed in a slanting position, in order to favour the passage of the material to the front, and so to facilitate the removal of the clinkers. The top of the destructor forms a perfect platform, having an opening over each cell into which the refuse to be burnt is shot from the collecting carts. The opening for the entry of refuse is divided from the opening for the exit of gases by a wall, and a bridge is built to prevent refuse which is heaped on at each charge from getting into the flue immediately below. Cells are provided with special openings for the introduction of infectious mattresses, and of diseased meat, dead cats and dogs, which fall direct upon the red burning mass, and are there consumed without nuisance. The clinkering is done about every two hours. To

FIGURE I.

FRYER'S PATENT DESTRUCTOR FURNACE.



these details I may add sundry improvements made by myself, in work at Ealing; the principal ones being, 1st, an automatic damper acting at the back of each flue, and shutting off four-fifths of the flue-space whenever the furnace door is open for clinkering, and so preventing the sudden rush of cold air into the flue; and 2nd, dishing out the ash-hearth, so that it will contain a certain quantity of water, thereby preventing the inconvenience of the dust when the ashes are cleared away, much to the comfort of the workmen.

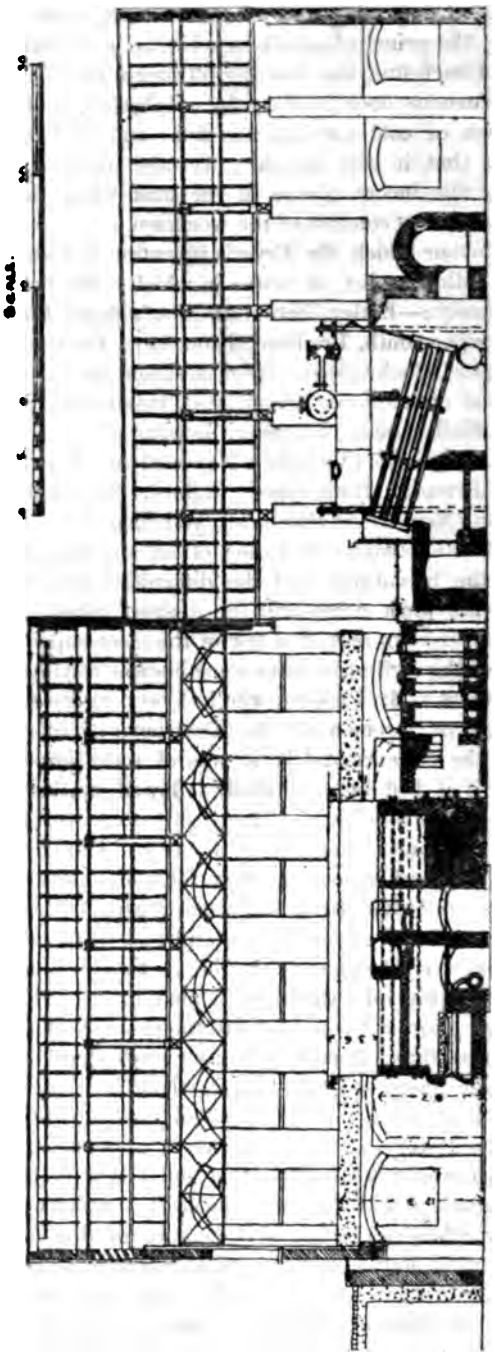
The favour which Mr. Fryer's invention met with may be gathered from the following list of towns in which it has been adopted more or less completely:—Batley, Battersea, Birmingham, Blackburn, Blackpool, Bolton, Bournemouth, Bradford, Broughton, Burslem, Burton-on-Trent, Bury, Buxton, Cheltenham, City of London, Derby, Ealing, Eastbourne, Georgetown (Demerara), Hampstead, Hastings, Heckmondwike, Huddersfield, Hull, Leeds, Leicester, London County Council, Liverpool, Longton, Melbourne (Victoria), Newcastle-on-Tyne, Nottingham, Para (Brazil), Preston, Rotherham, Salford, Southampton, Warrington, Wellington (New Z.) Whitechapel, Winchester.

To give in detail a description of all the attempts to deal with the question, the inventions, and the difficulties met with, would unduly prolong what must necessarily be a short paper. Sufficient for the purpose will it be to narrate a few of the most important.

One of the earliest to make a methodical attempt to deal with these difficulties was a Mr. Pickard, who had been in the employ of the Leeds Corporation as foreman of the Destructor Works. He called his invention the "Gourmand"; it was of some importance, and would no doubt, if it had been carefully followed up, have been a valuable invention. It consisted of a large fire arch, with two sets of furnace bars and two furnace mouths to one cell. The parts which I consider were of the highest importance were the flues and the second fires. The gases were conducted from the cells down a horizontal flue, in which Pickard had erected two ordinary fireplaces, with the fire crossing it, or the fire bars at right angles to the flues. He introduced exactly the first part of the principle which I adopted in my "Fume Cremator,"—*i.e.*, by the action of the second fire the gases of the cells were to have been purified, thus attempting in the most simple and obvious way to consume the gases, so as to resolve them into carbonic acid gas and water, and so to avoid the possibility of any offence. And as we look at the history of these important appliances, we find that the various improvements have been directed either to improve the furnace itself, or in one way or another to avoid the nuisance so often complained of, namely, offensive smells and discharges of fine dust. Next, Healey combined with Fryer, and erected a destructor at Bradford; and afterwards Thwaites introduced a boiler and refuse destructor combined, in which the heat of the boiling water and hot gases was said to prepare the refuse for combustion. Then came Young, of Glasgow, who arranged a destructor with closed ashpit and a powerful fan to facilitate combustion. The next to enter the field was Mr. Wilkinson, of Birmingham, whose destructor was somewhat similar to one invented

FIGURE II.

WARNER'S "PERFECTUS" DESTRUCTOR.



SECTION THROUGH FURNACES, CREMATOR, AND BOILER.

by Messrs. Pearce and Lupton, of Bradford,—but more successful. Another form was that of Burton, who constructed a long simple furnace with two fires, the refuse being dragged through by a long endless chain, which was moved at intervals by a windlass as the refuse became consumed. Messrs. Stafford and Pearson, of Burnley, invented the "Beehive," followed by the "Nelson," in which the gases of combustion are conducted over a reservoir of water, on the surface of which a small quantity of petroleum is allowed to run automatically, and are afterwards turned into a furnace heated with coke. Hardie, also of Burnley, introduced an apparatus consisting of saddle boiler, with an inclined furnace underneath, and driving air below through the fire artificially. Then Odger, also of Burnley, constructed a furnace in which the offensive gases were passed through a coke fire; and Horsfall, of Leeds, has designed one in which steam and air are thrown under the fire bars; this is now before the public, and the inventor is very sanguine as to its success. Amongst the more recent inventions we have that of the "Perfectus" destructor, by Mr. Warner (Goddard, Massey, and Warner), which has been adopted at Hornsey, Bournemouth, Newcastle-on-Tyne, and other places. It may be described as consisting (generally speaking) of a block of brickwork, 34 feet wide by 30 feet long, by 10 feet 6 inches high, strengthened on the front of each furnace with heavy segmental cast iron facia plates, to protect the brickwork, having sliding rails to support the furnace doors, with baffle plates of special construction, so that the fires may be examined quickly without allowing the admission of cold air. The ashpits are of the same width as the furnace arches, and their front parts are also covered with ironwork having sliding doors, so that they may be closed if necessary, and the air regulated or the fires blown up by means of a large blower, which forms part of the plant erected over the top of each furnace. There are two dampers worked from long, wrought-iron spindles, and balanced on the outside of the furnaces. These dampers are closed each time the men clinker, and each time they draw down fresh refuse to be burnt, so that the furnaces are kept very hot. Internally, the block of brickwork contains six reverbatory fire-brick arches, 5 feet long by about 10 feet. One half of the arch is made to cover a special drying hearth, upon which the refuse is prepared for actual combustion. The other half of the arch covers the fire-grate, which is made wholly of wrought iron, supported upon strong bearers. The structure is tied together by wrought iron tie-rods, and at the back and front supported by channel-irons, and at the ends by massive cast iron buck-stays. Over each damper a vertical flue is constructed, terminating in the main flue leading to the cremator, and is covered by a cast-iron frame and cover to allow a passage for workmen for cleaning. The top of the furnace forms a level platform, upon which the refuse is tipped from the carts as delivered. Each furnace has an opening, or hopper, capable of holding about the third of a cart load of refuse, and the contents of this hopper are discharged by means of a wrought iron lever projecting through the furnace roof; there are two doors at the end of the main flue for taking out fine dust, and there are special pockets at various distances provided

with frames and covers for cleaning purposes while the destructor is in operation. The engineer of the Hornsey Local Board speaks highly of this apparatus.

Passing on, as I have done, rapidly over the various inventions, we feel that the whole discussion has now passed beyond the stage of experiment, if not of criticism; for at the present moment the destructor is at work in some 40 towns in England, is in course of erection in several other towns, and is not confined to England, but is being adopted in our Colonies and in several Continental cities.

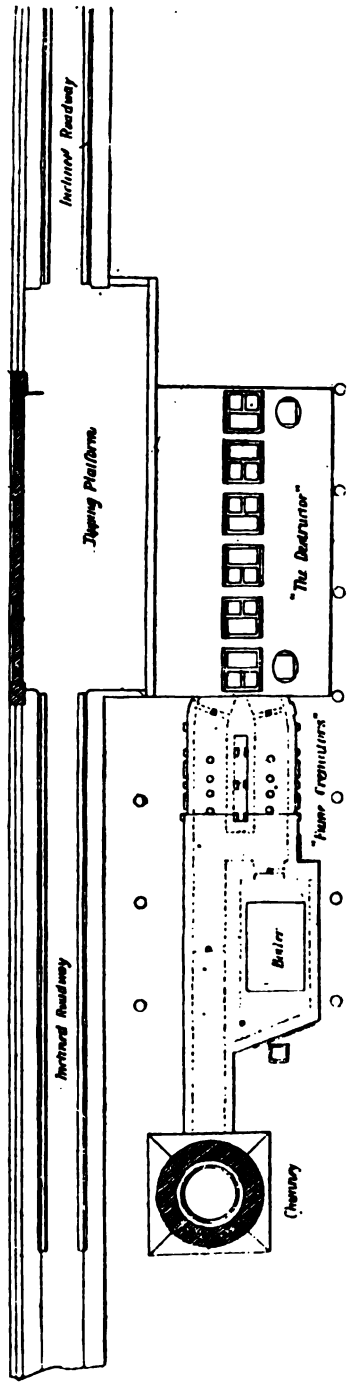
The garbage burnt varies very much according to the district; and the quantity of clinker and fine ash will vary in proportion to the class of material burnt. In some cases it has been as low as 10 per cent., and in other cases as high as 33 per cent. of the material collected. At Ealing, with which district I am officially connected, the average is 25 per cent., the residuum being a good hard clinker, but here it is applied to an altogether different purpose to that originally intended. The settlement or sludge in the sewage deposit tanks is pumped into sludge beds and mixed with the town refuse before it enters the destructor, thus solving, so far as Ealing is concerned, the much vexed sewage question. The residuum or clinker is valuable for various purposes, and is used for concrete, tar paving, artificial stone for building, and when ground up, as sand, paths, hardcore for roads, and makes a splendid and indestructable material for the construction of walls. So far, the house-refuse is transformed from a filthy and deleterious matter into a material at once inoffensive and useful. This does not, however, conclude the usefulness of the apparatus, it has still another property to which we shall have to refer a little further on, viz., its immense steam-producing power, heat.

The opposition which this useful invention has experienced in almost every town in which it has been fixed is almost incredible; and one would think, by the arguments advanced against it, that it was an invention of the devil rather than one of the most useful sanitary appliances which a town can possess. No doubt, in its earlier forms, there were defects; but at the worst they were as "nothing compared "with the offence and injury to health which are so successfully obviated "by the rapid destruction of tons of objectionable matter, which "must, in some way or other, be dealt with." We admit that, formerly, the vapours given off in the drying, and the vapour and gases given off from the material in the first stage of burning, and before it got well into the fire, were perceptible, and were the cause of complaint, as was also the very fine dust which escaped from the shaft. These are now things of the past, and the fact that some of our health resorts have the destructor in full and successful operation, whilst in London, in such suburbs as Battersea, Hampstead, and Ealing the same class of work is done, goes to prove beyond a doubt that the destructor, if properly worked, may be used anywhere and everywhere without the slightest fear of any complaint arising in connexion with the same.

FIGURE III.

PLAN OF TWELVE CELL "DESTRUCTOR" AND "FUME CREMATOR."

ERECTED AT BATTERSEA, 1887.



The experiments carried out at Bradford, by the Borough Analyst, in the autumn of last year, were most complete, and I think it well to include in the paper a copy of the same—simply stating that the destructor had been in use for some years, and it was found desirable, for reasons to which reference has already been made, and which apply to all the destructors, to add the "Fume Cremator" with the following result:—

BOROUGH OF BRADFORD.

EXTRACT from the REPORT OF F. M. RIMMINGTON, Esq., F.C.S.

October, 1889.

To the Chairman of the Sanitary Committee.

In accordance with your instructions, I have made four visits to the destructors in Hammerton Street, two visits before the "Fume Cremators" were in operation and two since.

Friday, October 11th, 1889. The "Fume Cremators" having now been in use more than a fortnight, and, therefore, considered in perfect working condition, I again visited the works, and made similar tests to those made on similar visits; the result, in every instance, indicating a decided improvement in every particular. The smell of the escaping vapours is of the first importance as far as the public is concerned, and this objection is now almost annihilated, only an almost imperceptible taint is present. Several experiments were continued for more than half an hour, passing through solutions intended to arrest any compound of sulphur, ammonia, or organic matter, with almost negative results; even the watery vapour from the steam jets appears to be decomposed, for only 5½ grains of water were obtained from 1 cubic foot (6½ gallons) of the vapour. This almost goes to prove that every compound is decomposed and reduced to its ultimate elements.

Wednesday, October 16th, 1889. The experiments on this occasion were the same as on the 11th inst., only carried on for a longer time. The smell of the vapour was exceedingly slight, and difficult to describe; the amount of organic vapour even less than before, almost *nil* in fact. Ammonia or any salts of ammonia were quite absent, and 0·19 grain of sulphuric acid was found in 1 cubic foot. A kitchen fire would yield much more than this. The effect of the gases from the furnaces passing through the "Fume Cremators" appears to be that all compounds are decomposed, and scarcely a vestige of any that can be construed to be offensive or obnoxious escapes, and in my opinion the result it as *nearly as perfect as it can be.*

(Signed) F. M. RIMMINGTON, F.C.S.,
Borough Analyst.

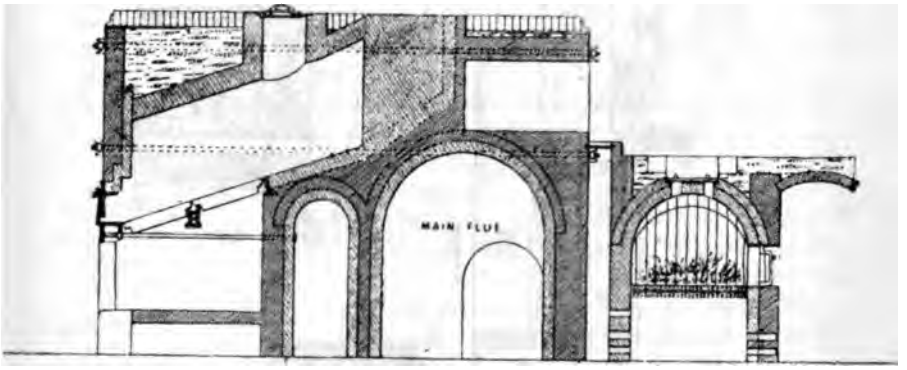
Speaking broadly, the attempts to avoid the nuisances complained of have been threefold. Air and steam have been driven through the furnace to render more active the process of combustion, and to consume the various vapours in their passage through it. Then, the gases have been conducted over troughs of water in the hopes of deodorising

the gases and precipitating the fine dust. And lastly, the gases from the furnace have been conducted through a second fire and there consumed.

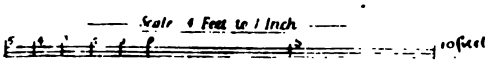
FIGURE IV.

EALING DESTRUCTOR,

WITH FUME CREMATOR ATTACHED.



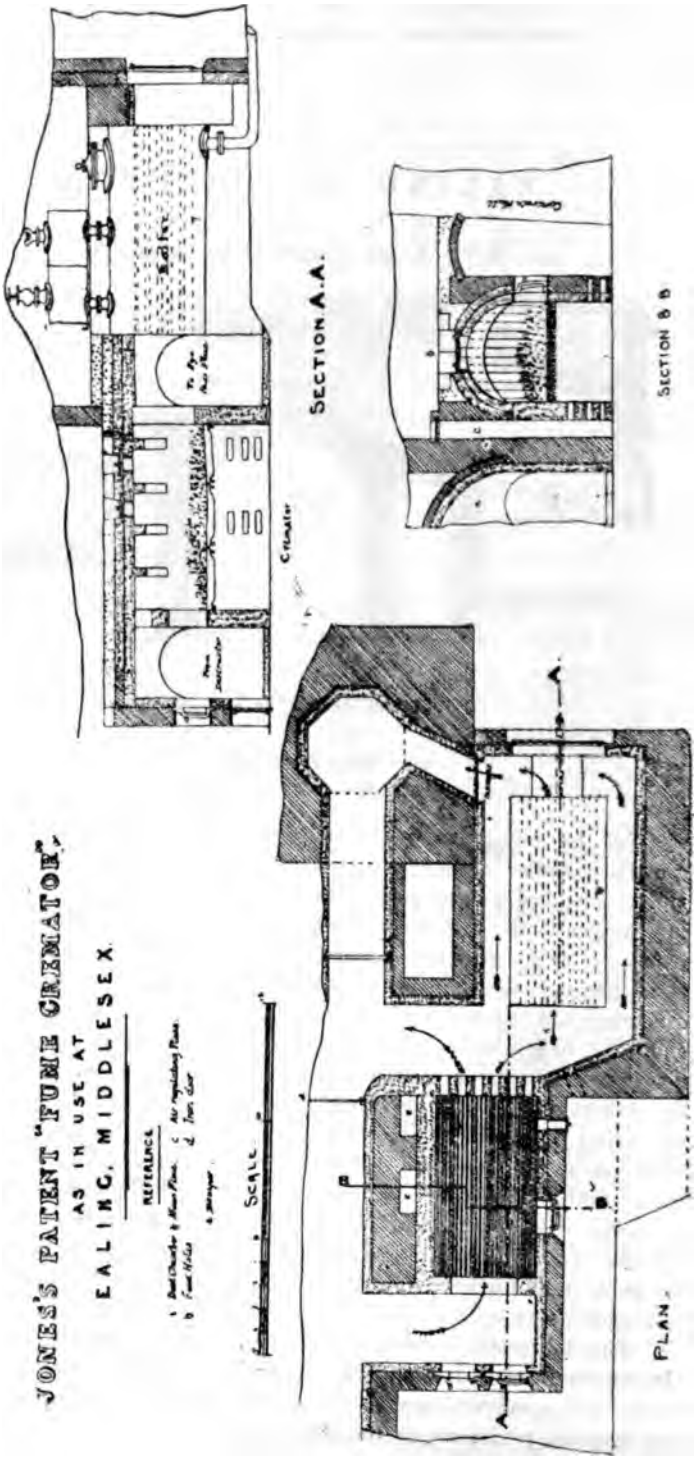
SECTION THROUGH CELL & CREMATOR



At the present time not many persons who have watched the growth of these appliances will doubt that the last is the best and most economical way of solving the difficulty. The simple contrivance now known as the "Fume Cremator" was the result of one of those happy thoughts which sometimes come as the reward of earnest investigation; the difficulties which assailed me at Ealing were the same that had engaged the attention of scientific men for some years, and it fell to my lot to solve them, and that in a very simple manner. The Fume Cremator consists of a reverberatory arch, with rings of fire bricks placed in the direction of the gases. Ribs of firebrick projecting from the arch serve to deflect the gases, and direct them on to the top of a red hot mass of fire. An intense heat, from 1,000 to 1,500 degrees, is maintained at little expense of fuel—*very fine coke breeze and the ashes screened from the refuse being all that is required*—by regulating the supply of air beneath the fire bars, and a further supply to feed the vapours as they pass into the cremator.

The following account of the most recently erected destructor (1891), viz., that at Leicester, as supplied to me by the engineer of the Leicester Corporation, may not be out of place as showing initial cost and the work performed by the destructor.

FIGURE V.


JONES'S PATENT "FUME CREMATOR",
AS IN USE AT
EALING, MIDDLESEX.
REFERENCE
SCALE
SECTION A.A.
SECTION B B
PLAN.

Borough of Leicester.

Destructor at Nedham Street.

22nd June 1891.

"Our Nedham Street destructor is a six-celled one, on Messrs. Manlove, Alliott & Co's system, with a Jones's "Fume Cremator," and a multitubular boiler, which provides steam for a 14 h.p. horizontal engine. The power is at present only used for driving a mortar and clinker crushing mill; but it is intended to erect jigger screens, which will be driven off this engine, for extracting ashes from the house-refuse for the cremator furnaces.

"This material, viz., ashes screened from the house refuse, is quite satisfactory *without* any other fuel.

"The stack is a little over 160 ft. in height, and cost about 1,000*l*. It abuts upon the destructor buildings, which are only five yards or so from a large board school, and there are a considerable number of houses of the artizan class immediately adjoining. There has been no complaint. The buildings are not of the mere shed type, but are of a thoroughly substantial character, consisting of office, tipping shed, cremator and boiler house, engine-house, and lime and mortar shed.

"They cost, including roads, drains, and a rather extensive area of granite paving and long lengths of retaining wall, about 3,300*l*. Total cost of the works, without land, 7,000*l*.

"Six stokers are employed, three on day and three on night duty, and they work off about 220 tons of ashes per week of 138 hours (last week, ending 20th June 1891, they did 6½ tons per cell per day of 24 hours).

"For the cremator we use about one ton of screened ashes per day, this being an addition to the above-named total quantity.

"The residue in the shape of clinker is about ⅛th (154 tons of ashes yielded 38 tons of clinker and flue-dust).

"The temperature of cells varies according to period of charge from 850 to about 1,470 degrees, and the temperature of cremator from 1,420 to 1,500 degrees.

"The whole borough yields about 38,000 tons of house refuse per annum, and it is calculated that the destructor will dispose of 10,000 tons at least.

"It is intended to at once erect two other destructors, one of six cells, and one of 10 cells.

"These works will be more complete in their arrangement than the Nedham Street works, inasmuch as it is purposed to use the engine power for driving mortar mills, screens for cremator ashes, pumps for water-supply to street watering posts, dynamo for lighting purposes, &c."

I desire to refer specially to an outside but most valuable feature in connexion with the destructor, viz., the immense amount of steam-

creating power that for many years has been literally thrown away. At Southampton the heat derived from the burning of the refuse is applied in connexion with a 30 h.p. tubular boiler, which is used for pumping some 500,000 gallons of sewage effluent, for the working of one of Shone's pneumatic ejectors, the driving of a dynamo for generating electricity, and for working the machinery in use at the sanitary works. At Hastings it is used for pumping sea water, and also for electric lighting. At Ealing, for driving machinery and electric lighting. At Blackpool, Preston, and other places, the immense power is utilized for electric and other purposes.

Every cell will burn sufficient fuel in 24 hours to keep a 5 h.p. engine going; and, as I have before stated, there are some 200 cells at work in England, equal to something like 1,000 horse-power. In most cases it may be said that the proper utilization of this power will effect a considerable saving, and, paying the principal and interest upon the 30 years' repayment scale, will leave a considerable balance. At Ealing this has been proved most thoroughly, leaving in this case a good balance in favour of the rates, inasmuch as, using coke breeze for the cremator, the cost for the 7-cell destructor is under 2*l.* per week of 7 days of 24 hours. When the destructor and cremator are not at work in consequence of repair, or for other reasons, the cost for fuel for supplemental boiler is 5*l.* per week, or a balance to the good of 3*l.* per week in favour of the destructor and cremator.

Before concluding this paper I wish to make a few remarks appertaining to one of the "burning questions" of the day, viz., the London sewage or sludge question. It will be remembered that one of the recommendations of the Royal Commission was resolved into the word "fire," and I am still sanguine enough to believe that at no distant date the advisers of the London County Council will see their way clear to giving a fair trial to the treatment by fire.

I have stated that in England at the present time there are some 200 cells at work employing less than 100 men, and dealing with something like 500,000 tons of refuse. How much room do you think these 200 cells would take, supposing they had been built at Barking, where I believe there are some 70 acres of land available? You will be surprised to hear that they can be put upon an acre of land, with plenty of room to work between them, and that the cost of erecting them would not amount to more than 300*l.* or 350*l.* per cell. Supposing the 200 cells had been built, and the question tried, there would have been, according to the data which we have, and which there is no disputing, as it is in daily work, 1,000 horse-power at hand, or in other words the coal bill would have been saved. No nuisance would have been created by the adoption of the process, which, after all that has been said with respect to other systems, has held its ground, and will do so. I refer to the milk-of-lime process, which will ultimately come about. I know that it may be replied that the effluent that is turned out by this process is not pure. No one in the present day would say that it is; but the question is, is it not pure enough to be discharged into the Thames at Barking and Crossness? I have been sending, to the satisfaction of

the Thames Conservators, from 750,000 to 1,000,000 gallons of effluent per day for many years into the Thames, and many visitors, and not a few of them members of the Metropolitan Board of Works, have asked Why cannot we do the same? And I say, unhesitatingly, that under the lime-process and the destruction of refuse, as suggested by me, the river would assume a character in every way satisfactory, and at a mere bagatelle of cost when compared with the expensive schemes already proposed. Other points might be raised in connexion with this effluent water, for instance, that of aëration. And here I may add that sufficient steam would be produced from the refuse, over and above the quantity required for ordinary pumping purposes, and might be brought to bear upon the effluent in aëration, which, to my knowledge, can be productive of immensely beneficial results.

On the Cleansing of the Streets and the Removal of Household Refuse in German Towns.

BY

TH. WEYL, Berlin.

1. With whom does the responsibility for the cleanliness of the streets rest?

(a.) *Thoroughfares and Foot Pavements.*—The principle generally acted on is that the persons resident in a street, and not the owner, shall be responsible for its cleanliness. In spite of this, however, the cleansing of the streets is, in most of the large towns, undertaken by the municipal authorities. In other towns, only a part of the roadway is cleansed at the expense of the authorities, the house-owners (resident) being responsible for the remainder. Moreover, the authorities have also undertaken the cleansing of street gullies, of public urinals, &c., the watering of the streets, and, in most cases, the removal of snow, &c. As a general rule, tramway companies are obliged to contribute towards the cost of the cleansing of the streets. The cleansing of the footways and pavements is left to the resident householders. In Berlin and other large towns the pavements also are cleansed by the municipal authorities.

(b.) *Household Refuse (Dust).*—The removal of dust has, in many cases (*e.g.*, in Berlin), been left to the house-owners; the town authorities, however, retain a right of supervision. In cases where the contract system obtains (*vide infra*), the contractor undertakes the removal of dust as well.

2. Who carries out the cleansing of—

(a.) *Streets, Squares, &c.?*—Some German towns, such as Bremen, Cologne, Munich, make arrangements with contractors for the removal of all street refuse at a fixed rate (contract system). In other towns (Berlin, Hamburg, Breslau, Frankfort-on-Main, Hanover, Leipzig) the

cleansing of the streets and the watering, &c. of the same, is carried out by the town authorities (municipal system). The necessary plant, such as brooms, barrows, street-sweepers, dung carts, watering cart, snow ploughs, &c. are the property of those by whom the cleansing is carried out. The draught animals do not seem to be, in any case, the property of the municipal authorities.

Of 23 German towns with a population of 100,000 in the year 1890, 13 employed municipal labour alone, six employed municipal and private labour, seven employed private labour alone.

3. Time at which the cleansing is effected, and frequency of the same :—

The cleansing of the streets is, as a rule, only done at night, and the removal of refuse is also performed either at night or in the early morning.

The frequency with which each street is cleansed depends upon the amount of traffic on the same. In Berlin, one-third of the whole street area is cleansed daily ; in Hamburg, one-fourth of the whole area.

Household refuse is removed, usually, three times a week.

4. Comparison between the employment of manual and mechanical labour in the cleansing of the streets :—

	Cost per Hectare.	
	Manual Labour.	Mechanical Labour.
	Marks.	Marks.
Frankfort-on-Maine - - -	11	6–8
Berlin - - - - -	32	18

5. Disposal and utilization of street and household refuse :—

Under the system of municipal working, the utilization of refuse has, up to the present, been comparatively restricted. It is carted off to dust-heaps, and there left to, so-called, natural influences ("naturforschen"). From April 1892, onwards, the city of Berlin proposes to spread its street refuse over some waste lands at a considerable distance from the city, so as to raise this low-lying and unproductive land to a higher level, and otherwise to improve it.

Under the contract system the contractors sell the household and street refuse as manure.

The plan of separating the rubbish into useful and worthless parts does not obtain to any great extent in Germany.

There is an establishment in Berlin for burning the refuse, but it is merely experimental.

Experiments in the Burning of House Refuse.

BY

J. F. MEYER, Chief of the Department of Streets and Sewers, Copenhagen.

It seems strange that at a Congress held here in London, a foreigner should come forward to discuss the subject of the destruction of refuse, but it is not my inclination to dwell upon facts which are generally acknowledged on this subject, and which England was the first country to fully appreciate, for in all sanitary municipal questions England has always been in the van, and has been the advocate of reform.

When Dr. W. Sedgwick Saunders, in his well-known report on the disposal of refuse, said, "The removal and disposal of refuse is a "problem which has exercised the intelligence and often strained the "resources of many a sanitary authority, and he who can indicate "the means whereby it can be successfully solved without detriment to "health or the creation of nuisance, should be regarded as a public "benefactor," he certainly, in a few words, put the case in the right light.

All who are assembled here certainly agree that the old system of disposing of refuse ought to be abandoned. It is only strange that it has taken so long before it has been acknowledged that the plan of dumping the refuse in places where houses are afterwards built for people to live in is altogether objectionable. It is perfectly permissible to use such refuse for agricultural purposes from a sanitary point of view; but it is well known that it is very difficult for a large town to get rid of it in this manner. Some localities may be very favourably situated for getting rid of the refuse by transporting it into deep water, &c. The question of the economical value of refuse has often been raised, and it has been said that it is wrong to deprive agriculture of this valuable material; but when circumstances are such that it is impossible even to get the agriculturists to fetch it for nothing, then every city must be allowed to regard its own interests first, and to get rid of its refuse in the most favourable way. From this point of view there is no doubt that the best way of disposal of refuse is destruction by fire. England has here shown the way, and the ever-increasing number of destructors is the best proof of the success of this method.

The reason why this method has only been used in rare cases on the Continent is, not that there has been any doubt as to its advantages, but because there has been some fear that the refuse of continental cities was not likely to be so fit for being burnt as that of English towns. Certainly there is a difficulty on this point, as everybody who has gone into these questions will have remarked that the English

refuse is much richer in such substances as unburnt coal than is the refuse of most continental cities.

The question now is whether the refuse that differs from the English by its want of coals can be burnt without the addition of combustible substances. The city of Copenhagen resolved to make some experiments to answer these questions, and it is these experiments and their results which I, who conducted them, have the honour of stating.

The destructor in which the experiments were performed was built at the municipal gasworks. In its construction much attention was paid to making the destructor as like the English destructors on Fryer's system as circumstances permitted, using the existing brickwork, &c. as far as possible to avoid unnecessary expense. The destructor was built in one of the old retort-furnaces not in use at present, after taking out the retorts, so that the old flues and the large chimney belonging to the retort-house were used. This chimney gave an excellent draught; but as the experimental furnace was the only source of heat for the chimney, the draught began to fail very quickly as the temperature of the furnace fell, so that there was only a suction of 12 to 10 millimetres (of water), while at a high temperature there was a suction of from 16 to 25 millimetres. If there had been other sources of heat, the bad burning in a single furnace would not have had this disastrous influence on the draught. For the rest, the furnace must, upon the whole, be said to correspond with a single cell of Fryer's destructor.

The burning experiments were divided into two parts :—

A. The Winter Experiments. — My original intention was gradually to use house-refuse from a series of different districts. By that means I hoped to be able to decide what influence the social position of the inhabitants and their way of living would have upon the refuse, particularly as to the relative quantities of coke and coal, together with the substances of animal and vegetable nature. This purpose had to be given up on account of practical difficulties.

I will state here that the weight of one load of house-refuse varied from 550 kgr. to 2,600 kgr.; while the average weight can be taken as 1,500 kgr.; one cubic foot weighs on an average 21 kgr.

All the refuse treated during the winter consisted almost entirely of house-refuse, on account of the weather.

The refuse from one district was exceedingly meagre. Almost no food-refuse was found, and very little coke and coals, but a considerable amount of ashes. The quantity of such finer substances (mainly ashes) was estimated by an experimental sifting, and it was then proved that in one cubic foot of refuse there were 0·58 to 0·33 cubic feet of particles less than one-tenth of an inch in diameter.

The refuse from some other districts was a good deal richer; and one cubic foot of refuse showed, when sifted, 0·42 to 0·33 cubic feet of fine ashes.

I. First experimental period (from January 30th to February 18th).

(*a.*) *Experiments with poor and middling refuse.*—After having dried the furnace properly and fired up with ordinary fuel, unmixed house-refuse was put in on the 30th of January in the morning.

For a preliminary drying it remained for an hour-and-a-half on the back plate made for that purpose, and was then spread over the fire in a layer six inches deep; it burnt very well, which was a direct consequence of the coke fire beneath. The residue was taken out after two-hours-and-a-half, and a new layer was spread over the fire left, though not so thickly, as already the first trial had shown that the great quantity of ashes checked the draught. In spite of this, the temperature sunk so much that a little coke fire had to be used in the front on the grate. The refuse was not sufficiently burnt, and the few remaining embers were not capable of lighting the next sample. The decrease by burning was, according to volume, only 15 per cent. An experiment repeated after having fired up did not succeed.

Experiments with added fuel were than tried; as fuel, coke-breeze, was used. It was mixed with the refuse in the same manner as when mixing concrete. The mixture consisted of one volume of coke-breeze and four volumes of refuse. The experiment carried out on 31st of January was satisfactory, the temperature was good, and the decrease of the volume 50 per cent.; 4·8 tons (at 1,000 kgr.) refuse were burnt in the first 24 hours.

Before continuing the experiments, it was tried if *less* fuel would give the same results. On the 1st of February, one part (volume) of coke-breeze and six parts of refuse were mixed. The temperature sunk lower, and the combustion was not complete. In 24 hours 4·8 tons were treated, but the decrease in volume was only 42 per cent.

The next thing to try was if a greater addition of fuel than a proportion of 1 to 4 would perceptibly increase the rate of burning. This experiment was carried out in 48 hours (on the 2nd and 3rd of February), so that the mixture was one part of coke-breeze to three parts of refuse, but it was proved that this addition was not advantageous: 4·2 and 4·8 tons were respectively burnt, with a decrease of 56 per cent. and 53 per cent. in volume.

The experiments were then continued with the proportions of 1 to 4 during the days from the 4th to the 7th of February inclusive. In each 24 hours, 5·4, 4·2, 4·2, 5·1, and 5·1 tons were burnt. The decrease averaged 50 per cent. of volume.

(*b.*) *Experiments with better refuse.*—The furnace was fired up with coke-breeze and on the 8th of February, at 2 o'clock, unmixed refuse was put into it. The draught during the firing was 22 mm. The temperature was rather better maintained than with the poor refuse, but still the draught had sunk down on the 9th of February in the forenoon to 12 mm., and the temperature was so low that a fresh firing with coke breeze had to take place. Experiments with unmixed refuse continued to give unfavourable results, as well as another experiment that took place in the night from the 9th to the 10th of February.

The next day the supply of refuse was not sufficient, and the heat in the furnace was therefore in the night kept up with refuse that happened to be in the gas-works, such as straw, paper, coal dust, sand, &c. In the day-time the richer refuse was burnt in the proportion of six parts refuse to one part of coke-breeze. Perfect combustion took place, but only 3·6 tons in 24 hours were burnt.

The addition of coke-breeze in the proportion 1 to 4 in these experiments gave 4·8 tons per 24 hours, and a decrease of 58 per cent. in volume.

I then tried to separate the finer parts of the refuse (ashes and sand), as it had been proved that it was these which most checked the combustion; three riddles with different openings were used for the sifting.

On the 13th of February sifted refuse was put into the furnace, which had been previously fired up. It burnt exceedingly well, and gave a high temperature. It caked more on the grate than in the earlier experiments, and the grate had therefore to be cleaned oftener. The stuff that had been sifted out was a mixture of ashes, sand, and organic matter, which afterwards smelt very badly, when left to stand for some time (the thermometer showed 54° C.).

As it proved that a considerable amount of this sifted refuse could be burnt, and as it was impossible during the next few days to procure a sufficient supply, I made up my mind to stop the experiments for some days, so as to get sufficient refuse collected and sifted to make more complete experiments. However, before stopping, I made some smaller experiments by burning sifted refuse from the 14th to 18th of February, mostly by adding coke-breeze to the finer matter that had been sifted from the coarser material. But even with a mixture of one part of coke-breeze to two-and-a-half parts of these finer matters, the combustion of the latter did not succeed.

II. Second Experimental Period (from February 23rd to March 12th).

Experiment with sifted refuse.—On the 23rd of February the furnace was again fired up, and sifted refuse was put in, and the stuff proved to be able to burn continuously without adding fuel.

Every 24 hours there was burnt, on the 23rd of February, 12·4 tons; on the 24th, 15·4 tons, on the 25th, 13·4 tons. The decrease in volume was in the proportion of 83 per cent., 83 per cent., and 75 per cent. The openings of the screens used for these experiments were large, but afterwards riddles with very fine openings were used, by which only the finest ashes and sand were removed. *This proved to be completely sufficient to make the stuff burn.*

The experiments of combustion gave the following results: on the 27th of February, 7·1 tons were burnt with 80 per cent. decrease in volume; on the 28th, and on the 29th of February, and on the 1st of March from 5·7 to 7·0 tons were burnt: on the average 6·2 per 24 hours with 60 to 68 per cent. decrease in volume. From the 2nd of March to the 8th of March, 7·6, 7·7, 7·1, 7·0, 5·8, and

5·9 tons were burnt per 24 hours with a decrease of 56, 60, 67, 80, 75, and 75 per cent.

On the 9th of March the refuse was so damp that a thorough-going treatment on the finer riddle was impossible. From the 9th to the 12th of March we tried how far this damp refuse could be burnt after it had been treated on the riddle with the larger openings. Complete combustion was possible, but was of course less rapid than with dry refuse. The damp refuse was burnt in the proportion of seven tons per 24 hours, with a decrease of 67 per cent. in volume. On the 12th of March the experiments ceased.

B.—The Summer Experiments (from the 25th August to the 27th August).

In these experiments the important thing to learn was whether the altered condition of the summer refuse (there being less unburnt coals and a great deal more vegetable refuse) would influence the combustion. As it proved impossible to procure unmixed house-refuse, stuff mixed with street-refuse had to be used.

The first result (using the screen with the largest openings) gave perfect combustion; but only four to five tons were burnt in the 24 hours, with a decrease of 70 to 75 per cent. in volume. The sifting had to be repeated, as the men were inexperienced, and because the stuff was mixed with street-refuse; after this we burnt six tons in the 24 hours, with a decrease of 77 per cent. With this the summer experiment ceased.

The clinkers withdrawn after the combustion formed a compact mass, in which glass, &c., was found in a molten condition; they were just like the results of combustion from the English destructors.

The above-mentioned sifting (the finer stuff that had gone through the riddle) was examined in the municipal laboratory. It is unnecessary to state the details. The result was that the stuff is chiefly gravel and sand, and that the quantity of organic matters is very small. It hence appears that the stuff cannot be advantageously used for manure, while it is not innocuous enough to be used for filling up. By arranging the furnace so as to let the products of combustion be conducted above and under the siftings, the stuff can however be very easily made innocuous. We found that after three hours all water had evaporated, and all organic matters had been destroyed. When treated in this way the stuff may be used for filling up, or for roadwork, &c.

In summarising the main results of these experiments, I must first state that what did not succeed with this primitive furnace might very well succeed with a regular destructor; and the latter would, of course, prove satisfactory in the cases which succeeded in our furnace.

The furnaces I have seen in England had the advantage of drying the stuff lying behind a great deal better, especially the lower layers. I could find no especial reason for this, but is probably one of the things as to which a little alteration in the construction of the furnace may have a great influence during the experiments.

The experiments have certainly proved that Copenhagen house refuse, which had not been prepared, could *not* be burnt. Of the above-mentioned modes of treatment, mixture with fuel is not to be recommended, while sifting seems to give successful results. The sifting ought to be less primitive than in the first experiments. The riddles may be moved by steam generated by the heat of the furnace itself, and this may be the rational manner of sifting. The best results are obtained with riddles with openings of about $\frac{1}{8}''$ to $\frac{1}{8}''$ in size. The riddles ought to be constructed so that a riddle with larger openings can be substituted when the refuse is too damp to be sifted through the finer openings.

The experiments show that the Copenhagen house-refuse, when sifted, is fit for burning, both in summer and winter, and can burn continuously. The quantity burnt in 24 hours, as well as the quantity and quality of the clinkers, are the same as have been found in other places, especially in England.

The expenses of a rational destruction by fire of the Copenhagen refuse will amount to the same as in the average of English cities.

I am convinced that this destruction by fire of house-refuse, which is so satisfactory in a sanitary point of view, will make its way on the Continent. When this is universally acknowledged and carried out, a new link will be added to the chain of domestic and municipal sanitary improvements, which the Continent has adopted from England; improvements, for which not only everybody here present, but all inhabitants of the Continent, will have to honour and thank England.

Refuse Burning.

BY

W. Geo. Laws, M.I.C.E.

Any paper on refuse burning must of necessity partly include the subject of refuse removal, as before we can discuss the advantages of burning the refuse of a city we must know of what it consists, where and how it is collected, and what part of it, if any, is so injurious to health that it must be quickly removed from the neighbourhood of human dwellings.

A short walk before breakfast in almost any part of London, or any provincial town, will furnish us with the needful data.

We see the scavenger leisurely sweeping into the channel the "slop" or "dust" (as it happens to have been a wet or dry night), for which no theory but that of "spontaneous generation" has ever fully accounted. It is diversified by paper in every possible form (except the clean sheet), but especially from the advertising hoarding, and dotted here and there with countless and indescribable odds and ends.

Many of the latter puzzle us until we notice on the sidewalk carefully set out before each door a series of boxes, pails, buckets, and anything that will hold, or will not hold, the various offal of a retail shop, paper, again as card boxes, wrappings, and cuttings, with ashes, straw, and sawdust, bottles, tins, and scraps of food.

If the district is residential there is more of the animal and vegetable refuse and less of the sawdust and straw, but still the paper and tin. If we happen to be near a market, the slop, &c. is rich and slab with relics of the particular goods dealt in.

We notice that a rough selection is being made among the rubbish already. All that comes under the scavenger's broom is shovelled into one form of cart, while the "box ashes," as they are technically called, are tipped into another, and still others are filled from baskets carried by the dustman from the interior of the houses in the residential districts. If these latter are followed to their dumping place there is still the same variety and still the same staples, paper, ashes, coal, bread, waste food stuffs, and wasted food, bottles, and the all-pervading tin. And whether the walk be taken in London or the provinces, in England or on the continent, Europe or India, there will be very much the same component parts, and but little difference in their proportions.

The first thing that strikes one is that amidst all this medley there is much that is useful, much that is harmless, and a good deal that is neither, but that these three classes are very badly mixed, and here we begin to touch the fringe of the refuse-burning problem.

That part of the material which contains enough manurial matter to be worth laying on the land is easily got rid of; and will pay its own carriage by rail far enough to clear the town of it, if sent as crude manure. If handled or treated in any way, either chemically or mechanically, its value is increased, but its cost raised as much or more. But the less of the other classes of stuff it contains the better the value as manure, and the wider the area over which there will be a demand for it. The best treatment we can give it is the negative one of not mixing it.

Again a great deal of the scavenger's part of the refuse is harmless and may be used to fill up excavations or to raise land, without any fear of future decomposition, and here also we must not mix it with either of the other two classes or it ceases to be harmless. We have, therefore, three broad classes of material to deal with, and practically in about equal proportions:—

(1st.) Crude manure, one-third.
(2nd.) Sound material, one-third.
(3rd.) Unsound stuff, one-third.

This last class is the troublesome part of the refuse to deal with. It cannot be used, cannot be left alone, and spoils whatever it is mixed with, we *must* get rid of it, and at any cost.

Well, we can send it off by rail and dump it in a convenient spot within the borders of some other sanitary authority. We do so, and

all goes smoothly for a while until one of two things happens, this friendly neighbouring authority changes its sanitary inspector, and he in the first flush of official zeal takes the gloss off his virgin broom by attacking our rubbish dump, and having right on his side, and well aware that he will not tread on the corns of his own masters, he covers himself with glory and sends us further afield in search of fresh fields and pastures new.

Or even worse, some fine day the heap gives unmistakeable signs of being on fire and rouses the country for miles around with hideous stinks, and the only remedy is to cover it with a thick coat of sand and retire, lucky if not indicted.

If our town is situated on a tidal river the troublesome material can be sent to sea, but here again difficulties beset us.

For about 50 days in the year the barges will not be able to get over the bar. In the winter season there may be a full week at a time when it is unsafe to venture out.

We must provide barge room enough for a week's supply to be kept on hand, and to be kept where it is pretty sure to become a nuisance, real or imaginary, it matters little which.

When we have got it fairly out to sea we find that one half of it floats, and though with the best intentions we have cast our refuse on the waters, after many days it may return to us and strew the beach at some neighbouring watering place, and again we are in trouble.

On the whole this is a dirty way of keeping the town sweet, and should only be adopted in cases of emergency, and until better means can be devised.

After all then we are driven to look for some means by which the obnoxious third can be dealt with within our own boundaries, and destruction by fire seems the only course available. It is at best but a clumsy mode of attaining our end, it is not at all a cheap plan, and worse, it is at present an unpopular one. But it is fairly effective and always available.

Theoretically, the stuff should be sorted and utilized, the useful parts sold, and the refuse made into manure. Unfortunately this cannot be done by town authorities at even a reasonable cost, and the manure making part gives rise to unholy stenches.

Private enterprise may succeed in paying expenses, and even in getting a small profit, but this has not yet been proved; certainly public bodies cannot—first, because they would be at once indicted for doing what private manufacturers may do with impunity; secondly, because there is no finality with public bodies, and they are constantly trying new and costly experiments, and making expensive alterations to their plant which swallow up any possible economy.

It is a pity that popular prejudice should have turned so strongly against refuse burning, as it certainly has the merit of very quickly resolving decomposable and, therefore, dangerous matter into its first elements, and with a minimum of nuisance in the process.

Even a large destructor furnace in full operation does less to pollute the air than the smoke from an ordinary dwelling-house. But popular prejudice is always unreasoning and generally unreasonable, and the more formidable on that account, as it is beyond the reach of argument or proof.

The destructor furnace is pretty well known, being merely a wide but shallow arch generally with the fire grate laid on a slope to facilitate charging. This is done from the upper end, the stuff being tipped down a sort of hopper mouth and pushed and raked in a uniform layer of about 12 or 15 inches thick, over the glowing embers of the last charge.

This description really covers the essential principle of refuse burning,—a fire grate of considerable area with a fire of moderate thickness and a good draught.

Very few real improvements have been made on the original pattern, and in most cases complication has only served to increase cost without improving the result.

Various plans have been tried for applying a forced draught, and though they have given good results, yet, when brought down to the final test of the cost per ton burnt, their supposed advantage vanishes.

A fault which has more than any other led to partial failure and public complaint, has been insufficient chimney power. Shafts have been built with too small an area for the work to be done, and hence too rapid a current.

The material burnt is one which naturally produces much dust, and a quick draught carries this dust with it out of the chimney to fall somewhere in the neighbourhood and causes a nuisance and legitimate complaint. On the other hand a shaft of twice the area would do the same work with a current of half the speed and most of the dust never reaches the outer air, but can be caught in very simple dust-traps.

The writer's experience decidedly leads him to prefer an ample natural draught (which may even require to be stopped down by dampers) to any of the forms of forced draught, which are an expensive way of getting work done by machinery that is too small for the purpose, and only justifiable where space is unavoidably limited.

The state of the material burnt leads to another form of nuisance. It contains from 25 to 40 per cent. of water, and sometimes, when sludge is burnt, even more. This moisture must be driven off in the form of steam, and however hot the fire, a certain time is occupied in the partial distillation, and fumes and empyreumatic vapours are carried over with the steam, which, however innocent, are very distinctly traceable by smell.

That they are harmless makes little matter, they are slightly pungent and aromatic, but distinct enough, and the honest British ratepayer has a nose of wonderful power when applied to the detection of official sins.

To meet this difficulty the fume-cremator has been devised by which the vapour from the destructor cells in passing to the chimney

is drawn over a bed of incandescent coke, and in so passing is raised to a heat of 1,200° to 1,500°, practically completing the partial distillation commenced in the cells, and resolving the empyreumatic vapours into their primitive gases, odourless at last.

The fume cremator has effectually met a real want, and gone far to render possible the introduction of the refuse destructor into situations where prejudice would otherwise have been too strong for it.

It may be useful to give the practical results of a trial of refuse burning extending over five years, in which care has been taken to set down accurately every item of expense, and so to arrive at a reliable result, in no way biased by trade considerations.

The authorities of Newcastle-upon-Tyne in 1885 determined to make a trial of refuse burning, and having secured a suitable site on their own property, put down the plant for a destructor of 12 cells.

Wishing to feel their way, they erected at first six only of these cells, which were completed in June 1886, and have been steadily burning night and day ever since.

The capital cost of erection was 5,060*l.*, which included a chimney shaft large enough for 12 cells, and also roads, tramlines, and other works necessary for the larger establishment, so that the increase to 12 cells now just completed has cost in all 7,000*l.*

The results now given are of the working of the six cells only, and they have been debited with the full capital at first expended, viz., 5,060*l.* The interest on this has been taken at 4 per cent. being one-half per cent. more than the Corporation of Newcastle pays on its stock.

No charge for redemption has been taken into account, it being considered that where the plant was fully kept up by repairs and renewals, a fairer estimate of the actual cost would be arrived at by taking interest only on capital, and charging repairs and renewals as they occurred.

The site on which the works stand had been let by the corporation for market gardens at 5*l.* per acre, and when handed over to the Sanitary Committee the rent was raised to 10*l.* per acre or 25*l.* for the 2½ acres occupied. Rates and taxes are charged as paid, the site being within the boundaries of another authority.

A careful and regular account has been kept of all the material brought to the destructor.

A charge of 1*s.* per ton is made to all private persons, tradesmen, and others, who send refuse for burning, and also when diseased meat or food stuffs condemned as unfit for use are dealt with.

Clinker and ashes are sold to contractors and others at what prices they will fetch, and when used by the corporation themselves are charged at the same prices as paid by the public.

These various receipts are treated as credit items and deducted from the total cost of burning.

The result of the whole five year's work is as follows :—

We have burnt 61,120 tons of material at a nett cost, including all expenses, of 3,097*l.*, making the cost of burning just over 1*s.* per ton, or more exactly 12·16*d.*

This cost may be divided thus—

	Per cent.	Per ton.
		d.
Interest, rent, rates, taxes, &c. -	37·6	4·56
Repairs and renewals - - -	8·8	1·10
Labour - - -	53·6	6·50
	100·0	12·16

With respect to this last item of labour there is a somewhat noteworthy fact to record. For the first three years and a half the work was done by two shifts of 12 hours each. At the end of 1880 there was considerable agitation in the labour market, and the gas stokers got a very material reduction of hours and increase of pay. The destructor men claimed a similar change, and the shifts were reduced to eight hours each, that is, three shifts are now employed working eight hours and resting 16 hours. The wages, by agreement with the men, remained the same per shift, so that the cost of labour was raised just 50 per cent. Naturally it was expected that the cost of burning would rise proportionally, that is, about 25 per cent., as labour formed about 50 per cent. of the work.

On working out the results, however, at the end of 1880 1 and up to date, the cost of burning, which up to the end of 1880 was 12·3*d.* per ton, has actually fallen to 11·9*d.*, or nearly ½*d.* per ton, while labour alone for the first three-and-a-half years was 6·9*d.*, and for the last 18 months 7·7*d.* per ton.

This is an interesting and significant fact, and though perhaps it is really more suited for discussion in another section of this Congress, yet the writer cannot but call attention to it as throwing a light on the labour question which must be specially interesting to engineers.

Here is a case where with identically the same plant and machinery, a lessening of the hours of work by one-third, viz. from 12 to eight, while increasing the total wage paid by 50 per cent., actually so far increased the output as to slightly reduce the cost per ton. It would be interesting to have the experience of other employers of labour in this direction.

To return to the experience gained at Newcastle, it appears that, with three shifts of eight hours each, the burning capacity of each destructor cell is slightly over 2,500 tons per annum, or eight tons per day of 24 hours. When it was attempted to increase this output it was found that the cell was not so well burnt and that the residue was more bulky.

As nearly as can be calculated the total residue is from 25 to 30 per cent. of the material burnt. It appears at Leeds, where the cells have been found very useful for many purposes, such as [illegible] which results at a cost per ton [illegible] the output has increased [illegible]

quarry where it is gradually forming useful land that will one day come into the market as building land.

The clinker has been much used for making the concrete bed in which the sanitary pipe sewers of Newcastle have been laid for the last nine years. It may be mentioned in passing that an ordinary sanitary pipe when thus laid in concrete for half its depth is just doubled in strength. A pipe 12 inches in diameter, which laid in clay, bore 30 cwts. laid on it before breaking, when laid in concrete required three tons to break it.

The great difficulty in the way of refuse burning is the securing of suitable sites for the furnaces. It is not easy to overcome the prejudices of the people, and each ratepayer is anxious that the work should be done at his neighbour's door and not at his own.

Probably every householder runs more real risk from the keeping of his own share of the refuse in his backyard than from the burning of the offal of a whole district within 50 yards of him; but the people have a great deal to learn as to their own interests and their duty to the community, and till a great stride has been made in that direction a needful reform will be cramped and hindered, and where not actually prevented will be saddled with difficulties and expense that ratepayers of the future will regret.

It is important that refuse destructors should be central for the district which they serve so as to reduce the cost of cartage, which generally far exceeds the cost of burning, and for the same reason they should be placed on low rather than on high ground so that the loads may be downhill. Taking Newcastle again as an example, carting the refuse up or down hill makes from 1*s.* to 1*s.* 6*d.* per ton difference in cost, more than the total cost of burning.

There should also be a ready means of getting rid of the 30 per cent. of residue which does not so far find a market. If this is to cart again, the cost becomes heavy.

The real value of a destructor is, that however clumsy and costly the plan of burning our refuse may be, it is at any rate effectual as a means of getting rid rapidly and completely of readily decomposable and, therefore, dangerous matter.

With proper destructor power and efficient daily collection of refuse it should always be possible to get rid of dangerous material within 24 hours, before it has time to ferment and develop its peculiar powers. In no other way can this be done with so much certainty or so quickly. There is also this further advantage that by so dealing with about one-third of the refuse we render another third saleable and the remainder harmless. And the cost of this advantage is 1*s.* per ton on one-third of the refuse, 4*d.* per ton on the whole. Surely not an extravagant price.

NEWCASTLE-ON-TYNE.

Five Years' Refuse Burning.

—	Refuse Burnt.				
	Box Ashes.	Ashpit Stuff.	Market Refuse.	Condemned Meat and Bedding.	Total.
	Tons.	Tons.	Tons.	Tons.	Tons.
1886-87 (9 months.)	6,675	405	216	27	7,317
1887-88	9,764	542	318	116	10,740
1888-89	10,356	546	323	91	11,316
1889-90	11,631	584	314	93	12,622
1890-91	14,263	390	403	142	15,198
1891 (3 months)	3,700	100	100	30	3,930
	56,389	2,567	1,668	499	61,123

Cost of Five Years Refuse Burning.

—	Rent, Rates, and Interest.	Labour.	Repairs and Renewals.	Total.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1886-87 (9 months)	230 0 0	207 0 0	21 0 0	458 0 0
1887-88	247 0 0	317 1 6	74 7 8	638 9 2
1888-89	245 0 0	317 17 3	41 13 6	604 10 9
1889-90	245 0 0	355 9 1	53 16 2	654 5 3
1890-91	245 0 0	492 19 2	86 6 10	824 6 0
1891 (3 months).	60 10 0	123 5 0	20 0 0	203 15 0
	1,272 10 0	1,813 12 0	297 4 2	3,383 6 2

—	Receipts.		
	For Burning Private Refuse.	For Clinkers and Ashes Sold.	Total.
	£ s. d.	£ s. d.	£ s. d.
1886-87 (9 months)	4 10 8	26 13 6	31 4 2
1887-88	32 4 4	30 5 6	62 9 10
1888-89	34 4 8	24 6 6	58 11 2
1889-90	34 4 6	16 17 5	51 1 11
1890-91	48 0 0	18 12 9	66 12 9
1891 (3 months).	12 0 0	4 13 0	16 13 0
	165 4 2	121 8 8	286 12 10

	£	s.	d.	£	s.	d.		d.
Total cost -	3,383	6	2					
Deduct receipts -	286	12	10	3,096	13	4		
Net cost -	3,096	13	4	61,123 tons.			=	12·16 per ton.

	£	s.	d.		Per cent.		Per ton net. d.
Rent, &c. - -	1,272	10	0	=	37·61	=	4·56
Labour - - -	1,813	12	0	=	53·60	=	6·51
Repairs - - -	297	4	2	=	8·79	=	1·09
					= 12·16 per ton net.		

How best to Dispose of the Refuse of Large Towns.

BY

WILLIAM BRUCE, M.D., LL.D., Medical Officer of Health for Ross and Cromarty.

This question has now narrowed itself down to destruction by fire. It has become impossible to deal with the many and various waste products of the household in cities by any other means. Their value as manurial agents is not equal to the cost of transport, and year by year the sums paid to the dust contractor for his trouble in disposing of refuse increases. Such being the answer to our query, what, then, is the best form of destruction? Is it to be by one large or many small destructions? The objections to large destructions are (1) the great bulk of the products to be dealt with, (2) the great expense of transport of the material to be destroyed, (3) the dangers of diffusion of disease, the necessary offensiveness of the process, and the noise of perpetually rumbling carts along the route traversed.

The advantages of small local destructions would be proximity, and the saving of the expense in cartage.

It has occurred to me that the best form of destructor would be a portable steam-engine, provided with a suitable fire-box, into which all combustible matter could be thrown. The heat generated by the burning of the refuse would, I calculate, be almost sufficient to propel the locomotive. Trucks would be attached, into which the cinders might be passed, and these could be stored at suitable depôts, such as railway stations. The plan of operation would be something like the following:—The traction-engines would start, each on its rounds, at 12 o'clock at night. As the engine passed along a particular street (notice having been previously given of its route), the ashes and other matters would be taken away in buckets of a suitable kind, and emptied into the furnace; and so, progressing slowly, the engine would finish its rounds about 5 a.m. next day.

The chief difficulty would be the smell of the gases set free. This need not trouble us much, since, 1st, almost all the houses would be shut up as the engine passed along, and, 2nd, effectual means, by steam-jet or otherwise, can be easily devised so as to make sure that every inch of gas is burned up before being allowed to escape into the atmosphere.

No doubt a certain amount of noise and vibration would accompany the process. These might be met by special construction of the engine, by cushions of steel, so to speak, on the wheel. On the whole, it may be safely asserted that the noise and vibration would be less than the noise and rumbling of carts. It would be very easy to show how this process of disposal of waste matter would be cheap. Take the tons of waste paper alone, and the bulk it occupies, carried miles and miles away, when it could be disposed of so easily by incremation. It is not altogether a far-fetched idea that, in times of plague and pestilence, cremation might thus be brought to the very doors where death and disease were playing havoc, and all traces of their progress at once dealt with and disposed of.

DISCUSSION.

Mr. Manning said there was one way of disposing of solid refuse which had not been alluded to, it was the way solid refuse was disposed of in Paris. The gardeners there brought a cart-load of carrots and cabbages and took away a cart-load of refuse from those vegetables, and that was used as manure, and it formed a manure of a very valuable character. If they were afraid of any smell by its decomposition before it got into the ground there were plenty of antiseptic products of a liquid or solid character that would suspend for a time the decomposition of this vegetable refuse.

Mr. Henry Whiley, Superintendent of the Health Department of the Corporation of Manchester, said Mr. Jones had mentioned that in the north they were a long way behind the south. He wished to state that in the north they had been burning refuse for the last 16 years. The Manchester Corporation were the first to build destructors, and they had continued their use ever since 1874-5, and were now burning at the rate of 80,000 tons a year. They had destructors of nearly all kinds working. There were some that were antiquated, and difficult and expensive to work and others which they had given up. It would be observed that Fryer's Patent Destructor was copied from theirs in 1874 or 1875. The refuse was then tipped from carts, and the material had to be dried before calcination, by the heat from the furnace door; the stench went up the chimney; but this was not the case now, with the new destructor. Mr. Jones had built a cremator, but that was not at all necessary. The refuse went in at the wrong end of the furnace. It ought to go in at the commencement without any handling; everybody objected to handle such stuff. He was ashamed to see men handling it, particularly that in the north, which was very bad to deal with. The principle was altogether wrong. The stuff ought to go in at the front and be projected mechanically, on movable fire-bars, and empty itself automatically, without being handled. No fume-cremator was required, because it cremated as it

went on. If it did not, then there was a special furnace suggested and invented by Mr. Davis, Inspector of the Alkali Works. Rochdale was the first town to construct it, and he believed that Manchester was the next. It did its work admirably. In a furnace, such as they had in Manchester, they could burn 10 or 12 tons in 24 hours, and destroy the fumes from the evaporation of 600 gallons of urine per hour, and there was no smell given off by the chimney. He wished to mention the matter, because they had met to devise the best means that could be adopted. In Manchester they had to get rid of a thousand tons of refuse a day, and they did it in various ways. Of course it was objected to everywhere. The only sensible people he had to deal with were the thinking working classes who fully appreciated the difficulty of the matter. Respectable people said, "Go anywhere, but do not come to us; go into the lower districts." He did not believe in that. He thought each locality should bear its own share, and he hoped that the time would come when everybody would be made to burn his own refuse. It was a very simple matter and saved a great deal of expense. As to the clinkers that came out of the furnace, it was abominable to have to draw the fire out every two hours. It was worse than being in a gas house. When sprinkling it with water to cool it, the stench from it was worse than the fumes from the chimney, and people complained of it most bitterly. The dust, also, was very bad. In London, all the neighbours complained of the dust. They had no dust in Manchester. They had had complaints about paper, but they had remedied that. After the Congress, nobody would burn paper for the sake of burning it. They would make paper of it again, and there would be no more complaints on that subject. With regard to the remark made by Dr. Bruce, they had tried that plan of collecting the refuse at night in Manchester. They did not try it with a steam-engine, but on tramways. But let them fancy having to carry the refuse of a large city from houses, many of them more than a mile distant from the tramways, and the suggestion became obviously impracticable. They converted most of their clinkers into mortar, of which they made from 10 to 12 tons a year. It was the best mortar in the town, and everybody used it, except the jerry builders.

Mr. Washington Lyon said that, as Mr. Jones had mentioned Dr. Saunders, Medical Officer of the City of London, and had also referred to the destructor used at Lett's Wharf, a few words from him (Mr. Lyon) would not be out of place, as he had taken part in the deputation that went with Dr. Saunders to Leeds to see the first destructor. The result was that they, after some little difficulty, did persuade the Corporation of London to adopt the destructor; but he agreed with Mr. Jones that they were not using that destructor properly. There was a prejudice on the part of some of the old officials against adopting these modern improvements; and until they get some younger men and had a few more Congresses like the present, they would have great difficulty in adopting modern systems of getting rid of the refuse. If they could only get the vestries and local boards to attend such Congresses they would be able to advance. He had been on the Camberwell Board between 30 and 40 years, and had been fighting this question from time to time. He brought it before the board only the other day. A deputation went to Ealing to see the destructors there. They all came back delighted. The sub-committee passed a resolution to adopt them, and when that resolution went before the board the gentlemen on the board said "No, we will wait a little longer." They all knew what that meant. They

must convert the masses; for until that was done these advanced notions could not be well carried out. He believed they were losing sight of the health question in connexion with dust. In the Corporation of London, before the erection of their destructor, there were about 100 women employed in separating the dust and rubbish. It was perfectly disgusting to see human beings at such an occupation. They succeeded, he believed, in getting rid of this system; but he heard that some of these women were still employed in doing part of the work, separating paper from the rubbish, when in a few hours the whole of it could be destroyed, and a residue left which would do no mischief to anyone, but which was useful for building purposes, tar paving, the foundations of houses, &c. Surely the day was come when they should try to adopt some of these systems, and not—as they were doing now—distribute disease in all directions by sending their filth all over different parts of London.

Mr. Alliott said a very large number of the furnaces to which reference had been made had come under his own personal observation. The number of cells of Fryer's destructor which had actually been constructed, and were in operation and ready for operation, would be more like 300 than 200, the number mentioned in the paper, and those cells were capable of dealing with from 80 to 100 tons of refuse each hour in a day. That the system of destroying refuse of that character by means of fire was extending, and extending somewhat rapidly, would be shown when he stated that during the present year something like 100 cells would be constructed and put to work, capable of dealing with something like 250,000 tons of refuse annually—taking into consideration that sewage work was stopped on Sunday, and often also for a portion of Saturday and the early part of Monday. One application of the system of burning refuse had not been mentioned. It was not because Mr. Jones was ignorant of it that it had escaped his attention, but perhaps he thought it would not be so generally interesting. It was the adoption of a special miniature furnace, very much of the destructor type, for dealing with such material as hospital refuse. Such material was of an exceedingly difficult character to deal with, because much of it was infectious. It could not with safety be carried through the streets or burnt in any ordinary fire. It was a great nuisance, and, if buried, the danger from it was not altogether done away with; and special furnaces, very much of the destructor type, had been introduced for the purpose of dealing with it. Whilst destructor furnaces of various kinds had been erected in different places, yet there was only one class of those furnaces—the Fryer's furnace—which so far had been adopted in any considerable number of towns. There was no other class of furnace which at the present time was used in more than two, or, at the very most, three places. Mr. Whiley had referred to the use of destructor furnaces in Manchester. It was quite true that when Mr. Fryer first patented his destructor furnace, Manchester was the first town to adopt that patented furnace; but when Mr. Whiley said that at present Manchester was ahead of all the rest of the world in regard to these matters, he must be ignorant of what the rest of the world was doing. At any rate, the merits of the system in use there had not been so obvious to those who visited Manchester as to lead to its extensive adoption elsewhere, as had been the case with some other furnaces.

Mr. Joseph Hall (Borough Surveyor, Cheltenham), said the only matter he wished to speak on was Mr. Laws' reference to the employment of labour. He had been through the same experience, and could fully

confirm it. He had tried it with lamp-lighters, with street-sweepers, and with every department. He found that by taking off the half-day on Saturday they actually gained by the alteration, and did not lose by it at all. He found that with the street-sweepers he could increase the quantity of work by one-fourth, and the wages by one-fifth, so that they got more work done, and better done at the same time. More work was done at a slightly less cost. They took two sections of men, and dealt with one on one plan, leaving the others as they were. Those that were dealt with under the new system he watched every fortnight as they came to the pay-table; and he believed it simply amounted to this, that they were getting better paid and therefore better fed. The whole question of labour resolved itself into that. If they were to have a full day's labour, such as they would expect from the best men, they must pay the others so that they could get that amount of food which would enable them to do it; and he did not think the ordinary rate of wages in many parts of England would allow of that. Where wages were 15*s.* a week they would, as a rule, get more work for 18*s.*, and better value than they did for the 15*s.*

Mr. C. Jones did not know that he had very much to say in reply to the criticisms that had been offered. They had been all fair, and the remarks of their friend, Mr. Whiley, had been particularly so. One did not mind an occasional dig in the ribs. They were all striving for one end, viz., to bring about a fine and splendid result from the Congress, and he could not but think that its outcome would be such as he would be the first to recognise, that the best man, the best apparatus, would win. In travelling about hither and thither in connexion with the Association of Municipal Engineers, they had gathered up ideas from one and another, which they had made use of, improved upon, and done the best they could in connexion with. He did not think there had been a single criticism made which he could call adverse. Nothing could be more interesting than the question of purification by fire, and, no doubt, ultimately they would have to consider the question of the destruction of London sewage rather than sending it out to sea. It was the third heading of the Royal Commission upon the very question to which they had been referring, and he was only surprised it had not been brought forward in connexion with their various societies.

Mr. W. G. Laws said that he, unfortunately, was not in the room when Mr. Whiley's statement was made. Some years ago he went to Manchester, and Mr. Whiley very kindly showed him, and some of the members of the deputation that went with him, the whole of the process by which the refuse was dealt with. They were extremely struck with the great ingenuity displayed in making use of every possible thing which had value in it. Mr. Whiley was kind enough to give the figures, and he was sorry the thing was not more widely known. It was, however, very well known within a couple of hundred yards of the place, they could not mistake it. When he got home, he worked out Mr. Whiley's figures, and, to his surprise, he found the cost of refuse removal and disposal in Manchester was 5*s.* per head. In Newcastle, where they did not go to that extreme, the cost was 2*s.* per head. He would admit that it was upon Mr. Whiley's experiments, at Manchester that his belief was chiefly founded, that it was better to let the stuff alone than to try to utilise it.

Mr. Whiley, in explanation, said Manchester was not a water-closet town, and the 5*s*. per head included dealing with the fæcal matter. That accounted for the difference between 2*s*. and 5*s*.

The President said there had been handed to him for presentation to the Section two very valuable books by Dr. Samuel Abbott, containing the result of experiments in America, one on the purification of sewage and of water, and the other on the examination of water-supplies. He was sure the Congress would authorise him to convey personally to Dr. Abbott their very best thanks.

Friday, 14th August 1891.

The Chair was occupied by
The President, Sir JOHN COODE, K.C.M.G.

Municipal Engineering.

BY

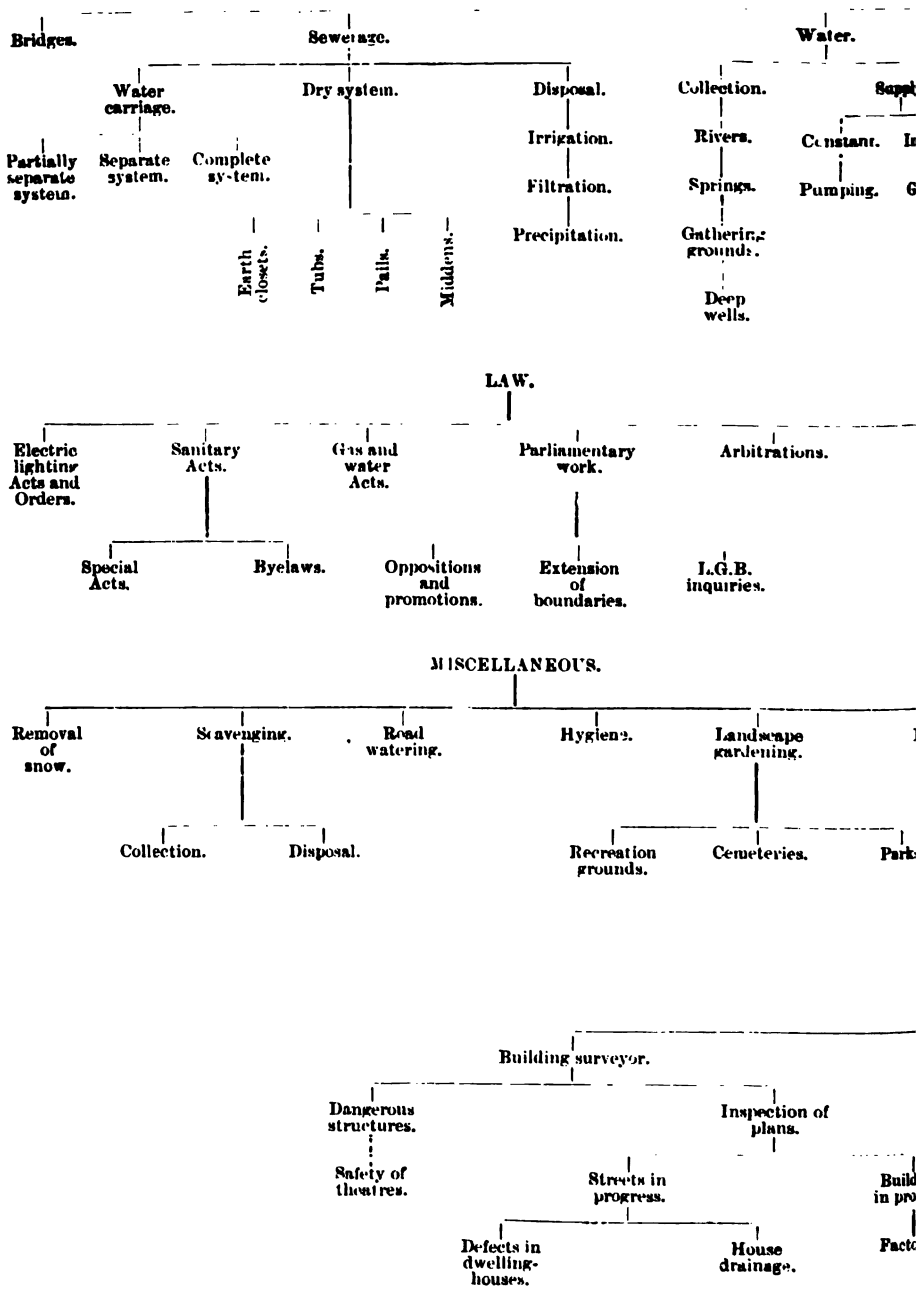
H. PERCY BOULNOIS, M. Inst. C.E., Fellow Sanitary Institute, Past President, Incorporated Association of Municipal and County Engineers, and City Engineer of Liverpool.

When I submitted the titles of one or two subjects to the Committee of Selection of this Section and their choice fell upon that of "Municipal Engineering," I felt some difficulty in dealing with a subject of such magnitude in the short time which is allowed for the reading of papers. It will consequently be necessary for me to exclude all detail, and to condense what I have to say into as short a compass as generalities will allow.

In the spring of this year, the "Times" and other newspapers contained some controversial correspondence upon the "Growth of Local Indebtedness," and when we consider that this growth has been mainly due to sanitary and other works carried out by municipal authorities throughout the country, it will be seen that the office of "municipal engineer" to a local authority is of some importance where the disposal of such large sums mainly passes through his hands.

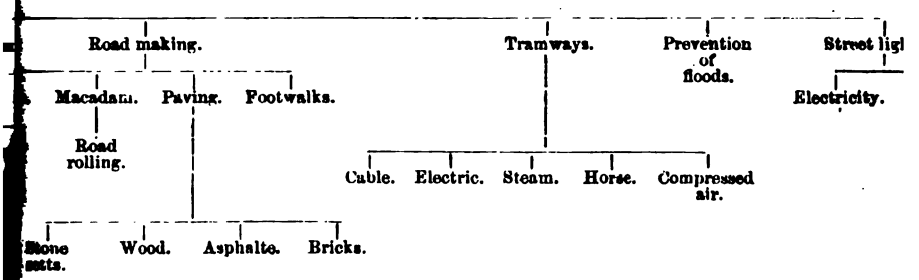
Sanitary engineering as a profession is of quite recent date. Fifty years ago very little attention was paid to sanitary matters, and the importance of pure water, of fresh air, and of the quick removal of organic waste were but little appreciated. Early in this century it does not appear that any towns possessed an officer whose duties were to deal with such subjects; and although a few of the larger cities became alive to the necessity of some action, and about the year 1840 some appointments

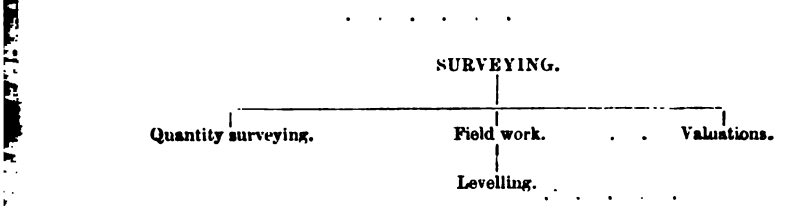
THE SIX CHIEF BR

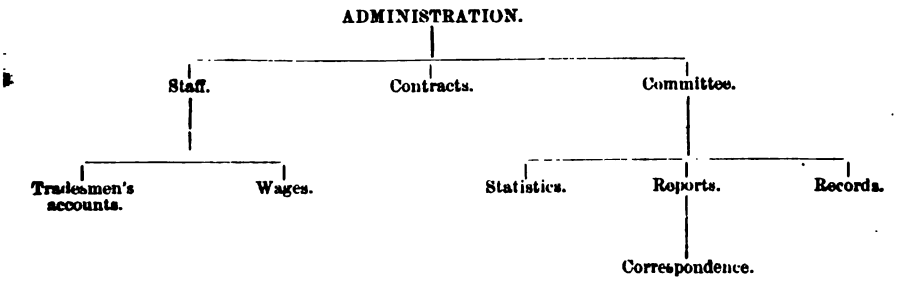


UNICIPAL ENGINEERING.

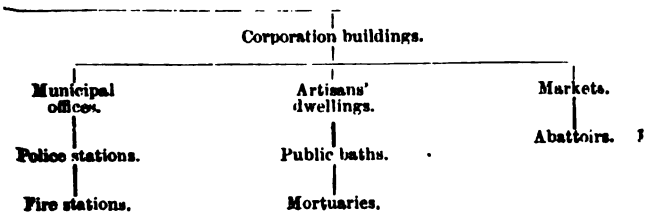
G.







RE.



were made similar to that of the "town surveyor," it was not till the year 1847 that this officer was first legalised under the Towns Improvement Clauses Act (10 & 11 Vict. c. 34. s. 7*). This was confirmed in the following year by the Public Health Act, 1848 (11 & 12 Vict. c. 63. s. 37.), and is now law under the Public Health Act, 1875 (38 & 39 Vict. c. 55. s. 189).

In the early days of the "surveyor," as he is legally called, his work was, as a rule, very different from what it is now. In a paper by Sir Henry Acland, read before the Association of Municipal Engineers and Surveyors in 1876, upon the Relation of Modern Engineering to Public Health and Local Government we find the following:—

"In the Public Health Act of 1875, the summary of all health enactments, the name of engineer does not once occur in the 343 clauses. He is still the old 'surveyor' we all remember, the plodding, energetic man of highways and byways, whose Anglo-Saxon vigour broke forth from the garb of corduroy, from the measuring tape and links into the transcendent skill of Macadam." . . . . . "But then the surveyor of the present day may be called to advise on anything, from the form and cost of an earthern syphon trap, to the calculation for work to be done by engines which are to supply half a million of persons with water . . . . . to be responsible for the construction of sanitary mechanisms, from a housemaid's sink to an intermittent downward filtration farm. . . . . He is to be able to carry out all measures for prevention of infectious diseases advised by the medical authority; he is faithfully to observe and execute all lawful orders of the Local Government Board which may be hereafter issued."

These words, by so eminent an authority as Sir Henry Acland, summarise the development of the town surveyor into the municipal engineer; and the duties of that officer which he has touched upon open up the next part of my paper, that of the real work of the municipal engineer.

As I have already said, it would be impossible in a paper of this description to detail all the work which this responsible officer has to execute, and I have, therefore, prepared the following diagram, which will, I think, graphically describe some of the ramifications coming under the head of municipal engineering:—

Having described the ramifications of the diagram, and briefly alluded to the engineering and other topics thus set forth, I feel sure you will agree with me that municipal engineering requires a large and varied experience, unremitting labour and attention, and a constant acquisition of knowledge. On the public advantages derived from this

---

* The section is as follows:—

"The Commissioners shall appoint, subject to the prescribed approval, or where no approval is required subject to approval by one of Her Majesty's principal Secretaries of State, a person duly qualified to act as local surveyor of the paving, drainage, and other works authorised under the provisions of this and the special Act . . . . . and the Commissioners with the like approval may remove any such surveyor."

officer's work I will not dilate; well-paved and lighted streets, well sewered and drained towns, pure water delivered to all parts of our dwelling-houses, the sanitary improvement of those dwelling-houses, public recreation grounds and parks, the amelioration of the condition of the people, and many other things, all speak of the work of this officer. Time will not permit me to more than allude to his present position. I fear it will be many years before the unostentatious character of his work will be fully appreciated: local government is nearly always decried; the necessity for taxation in order to carry out unproductive works will for a long time be unpopular; but I believe that the day will come when nations will cease to glorify in politics, war, and pomp, and when those who are engaged in the daily task of battling against disease and death will take that position in the world which I believe is already accorded to them by those who are advanced in thought and science.

DISCUSSION.

Mr. H. A. Roechling (Leicester) said the chart which Mr. Boulnois had been good enough to prepare for that meeting was a very excellent one. The municipal engineer had often been looked upon as a being of no importance whatever, but when they came to look at that chart they found that it included six different heads, 27 sub-heads, and 72 others, making altogether 105 different subjects for which the municipal engineer was responsible. It was his (Mr. Roechling's) happy lot to serve under one of the most able municipal engineers that the world ever produced, the late Mr. Gordon, who always gave the best of his energies to his work, and who was cut down very suddenly with heart disease, killed, as it was said of him, by an over-conscientious discharge of his duties. When they considered that the municipal engineer had all these subjects to deal with, they need not wonder any longer at such a result. Although the subjects mentioned might be again divided under as many additional heads, Mr. Boulnois had omitted to state a most important one, and that was the worry connected with the work. When he had to deal not only with one or two gentlemen at the head of affairs, but with about 150 councillors as they had in London, it might well be appalling to look first at the number of heads and sub-heads, and then multiply them again, for then they could imagine what the worry really was. The municipal engineer was not only tied with his mind to his work, but some corporations thought they had a right to dispose of him body, soul, and spirit. This was an entire mistake; and the more it was recognised, and the more clearly municipal engineers themselves spoke out about it, the sooner it might be rectified; it was not only an absurdity, but it was a crying shame. When they further considered that besides all this work which the municipal engineer had to perform, his salary was very often totally inadequate to his laborious duties, they must come to the conclusion that the municipal engineer of the present day occupied a very onerous, and often a very harassing position.

Mr. A. R. Binnie said the fact was he knew too much about this question. They were all conscious of what had been so well put before them by Mr. Boulnois, the onerous duties they had to perform. They were aware also of those little worries that had been mentioned, but he

thought their duty to the public and to themselves was to try and do their best, waiting for their work to be properly appreciated as time went on.

Mr. J. Thornhill Harrison said he quite agreed with what Mr. Boulnois had pointed out as to the multifarious occupations and employments of municipal engineers. He hoped they would soon receive that acknowledgment which their services deserved, that they would be put on a good footing by the Government, and that their salaries would be made adequate to their work.

Mr. Boulnois, in reply, said he must take a very short discussion on his paper as showing that he had filled up all the blanks upon his diagram. He was afraid, when he submitted it, that he might have left out a great many subjects; for instance, the question of the prevention of the encroachment of the sea was a matter which in seaport towns engaged the attention of municipal engineers to a very considerable extent. And that was omitted from the diagram. As to the worry that the municipal officer had to go through, any man who was conscientious, and who took an interest in his work, was bound to worry, and the man who did not worry was not worth his salt. What he should do was not to let anybody know that he was worrying. After all, there were a great many compensations for the worry they had to submit to; for they did occasionally get a crumb of comfort in the belief that they had done their duty to the best of their power, and had in some way ameliorated the condition of suffering humanity. He should like to say a few words about the Association of Municipal and County Engineers, of which he was ex-president. That association held district meetings at which papers of great value were discussed, and the works of different towns inspected. Every town surveyor who attended those meetings went back with a considerable amount of knowledge derived from what he had seen and learned, in addition to exchanging ideas with officials from other towns. He wished to state publicly that it would be greatly to the advantage of local boards if they paid the expenses of their surveyor's attending those meetings, instead of expecting him to do it himself. Of course, in towns where officials were getting perhaps larger salaries, it was not so important; but in many towns where the surveyors were very poorly and inadequately paid, it appeared to be a great injustice that they should have to pay, out of their own pockets, the expenses of attending the meetings at which they gained information afterwards to be applied for the benefit of the ratepayers whom they were serving. In conclusion, he recommended the use of black calico and white paint for the preparation of large diagrams such as that which he had placed upon the wall; for although it was very formidable in size, he could assure them that it could be packed up in a very small compass.

Die Typhus-Epidemie in Altona 1891 und das filtrirte Flusswasser.

VON

W. Kümmel, Altona.

In den ersten Monaten dieses Jahres ist in einer grösseren Zahl deutscher Städte ein epidemisches Auftreten typhöser Erkrankungen beobachtet; zu diesen Städten gehört auch Altona, in welcher Stadt auch in den Jahren 1885, 1886 und 1888 der Typhus epidemisch aufgetreten ist. Während nun aber in den genannten Jahren auch in der Altona unmittelbar benachbarten grösseren Stadt Hamburg Typhusepidemien, deren Culminationspunkt zwei bis drei Monate vor dem der Altonaer Epidemien lag, herrschten, ist in diesem Jahre die Stadt Hamburg völlig verschont, ja die Typhusfrequenz dieser Stadt ungewöhnlich niedrig geblieben, während in Altona die Zahl der Erkrankungen ungefähr ebenso hoch, wie bei den Epidemien der Jahre 1886 und 1888 war, im Verhältniss der inzwischen durch die Einverleibung mehrerer nahegelegener Ortschaften erheblich gestiegene Einwohnerzahl berechnet. Hamburg, bei etwa 560,000 Einwohnern, meldete stets weniger als 10 Erkrankungen pro Woche, während Altona, bei 146,000 Einwohnern, durchschnittlich im November 8, im Dezember 11·2, im Januar 21·2, im Februar 103, ja in der dritten Februarwoche 147 Erkrankungen aufwies. Besonders auffällig war dabei, dass die unmittelbar an Altona stossende Vorstadt St. Pauli, deren Bodenverhältnisse, Bevölkerungsart und -Dichtigkeit den Altonaern durchaus gleichartig ist, gleich der übrigen Stadt Hamburg völlig verschont blieb, während die dieser Vorstadt benachbarten Strassen Altonas, wenn auch nicht ganz so viele wie andere entfernter liegende Stadttheile, doch eine sehr erhebliche Zahl von Erkrankungen zeigten. Wenn zwei Städte, deren Bauart, Bevölkerung, Lebensbedingungen sich so sehr gleichen, einer Epidemie gegenüber sich durchaus verschieden verhalten, so liegt es nahe, die Gründe zu erforschen, durch welche sich diese Verschiedenheit erklären lässt. Im Nachfolgenden soll versucht werden, dies zu thun, zunächst klar zu stellen, in welchen Dingen die Verhältnisse Hamburgs und Altonas von einander abweichen, um so die Unterlagen zur Lösung der Frage zu gewinnen.

Ein grosser Theil der Stadt Hamburg ist auf den Niederungen der Elb- und Alstermarsch, im Alluvium, erbaut, und besitzt, da die Gewässer der Alster, der Bille und der Hammerbrookkanäle durch Schleusen aufgestaut werden, einen ziemlich constanten Grundwasserstand. Sehr beträchtliche Theile der Stadt, fast die gesammte Neustadt, der östliche Theil der Altstadt, die Vorstädte St. Georg zum Theil, St. Pauli fast ganz und die meisten sogenannten Vororte sind auf Geestgebiet, im Diluvium, erbaut; hier schwankt der Grundwasserstand stärker, soweit er nicht durch die schon seit langen Jahren vollendete

Canalisation des gesammten Stadtgebietes festgelegt wird. Altona liegt fast in seiner ganzen Ausdehnung auf dem Geestgebiet, im Diluvium, und zwar ist die Bodengestaltung derart, dass in nächster Nähe der Elbe die höchste Erhebung des Bodens liegt, von welcher das Elbufer steil gegen den Fluss abfällt, während das gesammte Stadtgebiet von dem hohen Uferrücken aus nach Norden sanft sich abdacht, nach Osten zum Theil stärker fällt gegen den die Grenze der beiden Städte bildenden früheren, jetzt canalisirten Grenzgraben, in dessen Nähe eine räumlich sehr beschränkte Fläche im Alluvium belegen ist. Der Untergrund der Geest ist Lehm und Sand, der Untergrund der Marsch Thon und Moor. Im Stande des Grundwassers verhält sich der gesammte Untergrund Altonas wesentlich abweichend von dem der Marschteile Hamburgs. In Altona wechselt, namentlich in der auf Lehmboden erbauten erheblich grösseren westlichen Hälfte der Stadt, die Höhe des Grundwasserstandes sehr bedeutend; hier sind ganze Strassen, in denen alle Keller an Grundfeuchtigkeit, mitten im hohen Sommer an Grundwasser leiden, und durch allerlei Hülfsmittel und Mittelchen nicht trocken zu legen sind. Auch in Hamburg giebt es einzelne Gegenden mit ähnlichen feuchten Kellern, doch nicht in der dicht bebauten Stadt, wie in Altona, und nicht in gleicher Ausdehnung.

Die Art der Bebauung ist in beiden Städten einigermassen gleich, auch die Wohnungsverhältnisse sind sich ähnlich, in Altona im Ganzen aber dürftiger. Die Einwohner beider Städte, wenn auch dem gleichen Stamme entsprossen, unterscheiden sich doch in manchen Einzelheiten, vor allem aber darin, dass die Bevölkerung Hamburgs ganz erheblich wohlhabender ist als die der Nachbarstadt, in welcher der billigeren Wohnungsverhältnisse wegen zahlreiche Arbeiter und Gewerbtreibende wohnen, die in der grossen Handelstadt ihren Beruf ausüben und ihr Brod finden. Ganz besonders fehlen Altona fast vollständig die in Hamburg sehr zahlreichen Grosskaufleute und der reiche Mittelstand, welcher es vorzieht, in einem eigenen Hause mit Garten allein zu wohnen, anstatt in den bekannten "Etagenhäusern," Miethskasernen, mit mehreren, oft recht zahlreichen Familien ein Haus zu theilen. Diese Miethshäuser, Revenueerben genannt, deren einziger Zweck darin besteht, ihrem Eigenthümer eine möglichst hohe Verzinsung seines Kapitales zu liefern, giebt es in beiden Städten massenweise, in Altona im Verhältniss zu den Einzelhäusern aber weit mehr. Ihre Erbauer, denen thunlichst billige Herstellung der Gebäude zur Erreichung des Zweckes die Hauptsache ist, führen einen stillen Kampf gegen die im Interesse der hygienischen und bausichern Anforderungen erlassenen Baupolizeigesetze, indem sie in den weitaus meisten Fällen das in den Gesetzen bestimmte Mindestmass der Anforderungen an gesundes Wohnen thunlichst genau einzuhalten, wenn möglich durch geschickte Auslegung des Wortlautes noch zu unterbieten wissen. Die Folge davon ist dann ein Zusammenpferchen der Einwohner, eine Beschneidung von Luft und Licht bis an die Grenze des Möglichen und nur irgend Erlaubten, und wenn in den letzten Jahren in Altona, in Folge erheblich verschärfter Gesetze und strengerer Controlle durch

die Behörden es wesentlich besser geworden ist, so bestehen doch noch erbärmliche Wohnungen in sehr grosser Zahl, werden auch jetzt noch immer Wohnungen, welche früher einer Familie eben ausreichenden Raum gewährten, in zwei und drei Theile getheilt und an zwei bis drei Familien vermiethet, die dann in allen gesundheitlichen Lehren spottender Weise in diesen völlig unzulänglichen Räumen untergebracht werden. Leider bieten unsere Gesetze den Behörden nur sehr unzureichende Handhaben, derartigen Ueberfüllungen der Wohnungen entgegen zu wirken; die von dem deutschen Verein für öffentliche Gesundheitspflege entworfenen Bestimmungen über gesundes Wohnen sind bisher noch nicht von den Reichsbehörden zum Gesetz erhoben. Dass durch derartige Uebelstände die Gesundheitszustände einer Stadt herabgedrückt, Epidemien befördert werden müssen, ist wohl unzweifelhaft, wie es auch wohl nicht zu bezweifeln ist, dass in Altona, wo sie wesentlich schlimmer sind als in Hamburg, sowohl absolut wie im Verhältniss zu der Zahl der durchaus guten und unbedenklichen Wohnungen, eine einbrechende epidemische Krankheit sich stärker und leichter entwickeln kann, als in Hamburg mit seiner durchschnittlich wohlhabenderen, besser genährten und besser wohnenden Bevölkerung.

Bezüglich der Entwässerung stehen sich beide Städte ebenfalls ziemlich gleich, doch auch hier Hamburg besser. Letztere Stadt hat bald nach dem grossen Brande 1842 bis zum Jahre 1848 die derzeit abgebrannten Strassen vollständig canalisirt, und dann von 1853 an das Sielsystem über die ganze Stadt und die Vorstädte ausgedehnt, sodass gegen 1860 die derzeit städtisch bebauten Theile sämmtlich mit tiefliegenden Canälen in bester Weise ausgestattet waren. Von 1871 an hat man ferner ein grosses Stammsiel für die Entwässerung der Land- und Aussendistricte gebaut und nach dessen Vollendung alle bewohnten Gegenden mit Sielen versehen, sodass in der bebauten Stadt mehr als 300 Kilometer Siele vorhanden und schon seit Jahren nur in neuen, der Bebauung zu erschliessenden Bezirken neue Siele zu erbauen sind. In Altona hat man mit der Erbauung von Sielen erst sehr viel später begonnen; nachdem in den Jahren 1855–57 der Grenzgraben zwischen Altona und Hamburg canalisirt war, begann man zu Anfang der sechziger Jahre die diesem zunächst liegenden Strassen und dann weiter den höher gelegenen Theil der Stadt mit Sielen zu versehen, später auch den nördlichen Abhang der Stadt mit zum Theil sehr flach liegenden Sielen nach der Isebek, einem in die Alster mündenden Bache zu entwässern, es waren aber im Jahre 1880 im Ganzen erst 25·5 Kilometer Siele erbaut. In den Jahren 1882–85 ist, da das Grenzsiel erheblich überlastet war und jeder stärkere Regenfall heftige Ueberschwemmungen der Keller veranlasste, ein Parallelsiel des Grenzsieles erbaut, auch das nördliche Stadtgebiet zum Theil an dieses, zum Theil an das Hamburger Geeststammsiel angeschlossen, sodass seit wenigen Jahren die vormalige Stadt Altona bis auf einige Strassen vollständig canalisirt ist. Dagegen ist die vormalige Stadt Ottensen, welche 1888 in Altona einverleibt wurde, nur zum Theil, und zwar die südlich gelegenen Strassen in den letzten Jahren nach der Elbe zu, die nördlich

belegenen und die Strassen des alten Dorfes nach der Isebek in zum Theil sehr mangelhafter Weise schon länger entwässert. Heute beträgt die Länge der in Altona vorhandenen Siele etwa 40·5 Kilometer, immer noch erheblich weniger als die Länge der bebauten Strassen.

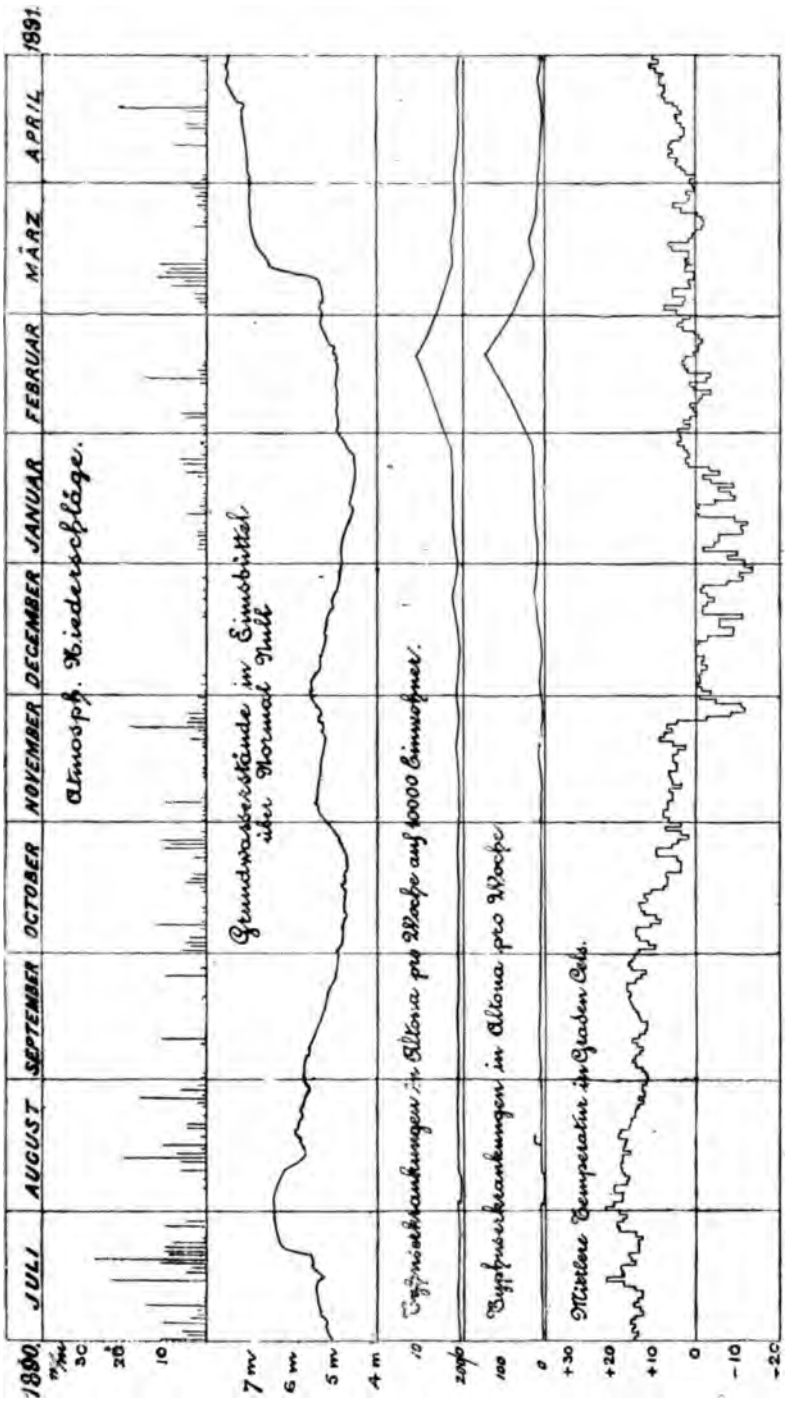
An die Siele müssen in Hamburg schon seit langen Jahren alle bewohnten Grundstücke angeschlossen werden und in diese ihre unreinen, insbesondere die menschlichen Abflüsse abführen; in Strassen, welche mit Sielen versehen sind, mussten die früher allgemein üblichen Eimerprivets beseitigt und durch Wasserclosette ersetzt werden. Altona gestattete in seiner Bauordnung von 1874 die Anlage und den Anschluss von Wasserclosetten, schrieb ihn aber erst 1877 für alle Neubauten und grösseren Umbauten, und erst im September 1888 für alle Grundstücke vor, welche an Strassen mit öffentlichen Sielen belegen sind. In diesen, also nahezu in allen älteren Gebäuden sollte bis zum 1. Oktober 1889 der Anschluss an die Siele hergestellt, die bestehende Einrichtung von Eimerprivets beseitigt und die Ableitung aller unreinen Abflüsse, sowohl von den Höfen als von den neu anzulegenden Wasserclosetten in die Siele ausgeführt sein. Die Folge dieser Handhabung der Gesundheitspolizei war, dass bis zum Jahre 1888 nach und nach in den besseren alten Gebäuden und Neubauten der Jahre vor 1877, sowie in allen Neubauten an besielten Strassen des südlichen Entwässerungsgebietes nach 1877 allmählich Wasserclosette die frühere mangelhafte Beseitigung der Excremente verdrängten, jedoch erreichte deren Zahl in der ganzen Stadt im Jahre 1888 noch nicht 9,000, bei mehr als 105,000 Einwohnern. Erst als die Verordnung von 1888 erschien, und gleichzeitig in den Strassen, welche früher nach der Isebek entwässerten, die Einleitung der Fäkalien in die Siele erlaubt wurde, wurde die Anlage von Wasserclosetten allgemein, und stieg deren Zahl von 9,000 auf mehr als 20,000, trotzdem noch immer der grössere Theil des Stadttheils Ottensen keine Closette anlegen durfte. Mit der Zahl der Closette stieg aber gleichzeitig auch die Zahl der Anschlüsse an die öffentlichen Siele; solange dieser Anschluss nicht zwangsweise gefordert wurde, unterblieb er in den meisten alt bebauten Grundstücken ganz oder wurde höchstens bis zu einem bequem gelegenen Punkte auf den Höfen geführt, an dem das Schmutzwasser entleert werden konnte. Die erzwungene Anlage von Wasserclosetten, welche von den Höfen, dem Aufstellungsorte der Eimerprivets, in die Wohnungen, oft auch nur in die Keller oder Dachräume verlegt werden mussten, führte zu der Einführung der Abflussleitung bis in die Wohnungen und veranlasste, dass in den Küchen Einrichtungen zum Ausgiessen des Schmutzwassers ausgeführt wurden, die bis dahin in den billigeren Wohnungen nahezu allgemein fehlten. Die Ausgüsse wurden naturgemäss mit Wasserzapfstellen verbunden, sodass die Bewohner nun in ihrer Wohnung, und nicht an gemeinsamer Zapfstelle auf dem Hofe ihr Brauchwasser nehmen konnten, und wurde durch diese Verbesserungen erst der Zustand herbeigeführt, welcher in Hamburg schon längst bestand und in jeder grösseren Stadt vom gesundheitlichen Standpunkte aus als der allein zulässige bezeichnet werden muss.

Die Wasserversorgung erfolgt für jede der beiden Nachbarstädte selbstständig. Hamburg besitzt seit 1849 eine von W. Lindley erbaute Centrale Wasserversorgung, für welche jetzt eine Sandfiltration eingerichtet wird; sie versorgt ihre Abnehmer bis heute noch mit unfiltrirtem Wasser, welches der Elbe oberhalb der Städte bei Rothenburgsort entnommen wird. Altona dagegen wird ebenfalls aus der Elbe versorgt durch eine Centralanlage in Blankenese, etwa 12 Kilometer unterhalb der Grenze beider Städte, welche seiner Zeit nach Sir Thomas Hawksley's Vorschlägen erbaut, und seit 1859 in Betrieb und mit einer vollkommenen Sandfiltration ausgestattet ist. Das Altonaer Wasserwerk versorgt ausser Altona auch die Dorfschaften, welche zwischen dem Werke in Blankenese und Altona liegen und zahlreiche von reichen Hamburgern bewohnte Landhäuser mit schönen Parks enthalten. Die Schöpfstellen beider Wasserwerke liegen in Flutgebiet des Stromes, die Flut dringt noch, je nach den Oberwasserständen 20 bis 40 Kilometer oberhalb der Hamburger Schöpfstelle aufwärts in den Fluss; man will aber ermittelt haben, dass der Abfluss aus den Hamburger Sielen, welcher ungereinigt dem Strome zugeführt wird, selbst bei stärkster Flut nicht bis zur Hamburger Schöpfstelle gelangen kann. Dies ist naturgemäss für das Blankeneser Werk nicht erreichbar; für dieses muss einerseits auf die grosse Menge des nicht verunreinigten Wassers aus den verschiedenen zwischen Hamburg und Blankenese sich vereinigenden Stromarmen, sowie auf die Selbstreinigung des Flusses auf dem 12 Kilometer langen mit grosser Geschwindigkeit zurückgelegten Laufe, andrerseits auf die Vorzüglichkeit der Filteranlagen gerechnet werden, um durch das Zusammenwirken aller dieser Kräfte aus dem Wasser diejenigen Verunreinigungen zu entfernen, welche ihm die Abflüsse einer Bevölkerung von mehr als 700,000 Seelen zuführen. Wie sehr dies gelungen, beweisen die Resultate der bakteriologischen Untersuchungen, welche früher mehr gelegentlich, seit etwa Jahresfrist regelmässig, und zwar nach der Methode von Professor Dr. Robert Koch erfolgen, einerseits durch das Untersuchungsamt der Provinz Schleswig-Holstein in Kiel, bezw. dessen Vorsteher Dr. R. Wollny, andrerseits durch die Ingenieure des Wasserwerks selbst, welche sich entsprechend ausgebildet haben. Ob das Hamburger Wasserwerk sein Wasser gleichfalls bakteriologisch untersuchen lässt, ist uns nicht bekannt; veröffentlicht sind bisher ab und an einzelne Untersuchungen; wir haben auch wiederholt Versuche mit im Innern der Stadt geschöpftem Wasser angestellt, haben aber stets gefunden, dass die Zahl der entwickelungsfähigen Keime die im allgemeinen als zulässig anerkannte höchste Zahl so ausserordentlich übersteigt, dass von diesem Standpunkte aus das Hamburger Wasser als ein gänzlich unzulässiges bezeichnet werden müsste, wenn nicht andrerseits unzweifelhaft feststände, dass dieses Wasser ohne Schaden für die Gesundheit täglich von vielen tausenden von Menschen benutzt wird.

Bezüglich des Klimas, der Regenfälle u. s. w. kann zwischen den beiden Städten ein Unterschied von irgend welcher Bedeutung nicht bestehen. Es ist deshalb zulässig, die von der Kaiserlichen Seewarte,

belegen in St. Pauli etwa 1 Kilometer von der Grenze beider Städte, ermittellten und täglich veröffentlichten mittleren Temperaturen und Niederschlagshöhen als für beide Städte gleich zutreffend anzusehen. Grundwasser-Beobachtungen werden von amtlicher Stelle weder in Hamburg, noch in Altona angestellt; die einzige, schon über längere Jahre sich erstreckende derartige Beobachtung geschieht durch den Beamten des Hamburger Medicinal-Bureaus, C. C. H. Müller auf dem kleinen Schäferkamp, etwa 500 Meter von der Altonaer Grenze entfernt. Bei dem Mangel eigener Altonaer Beobachtungen ist diese in der Nähe angestellte wohl zum Vergleich heranzuziehen, da bei den jedenfalls gleichen Niederschlagsmengen auch die Grundwasserschwankungen des Hamburger and Altonaer Geestgebietes nicht wesentlich von einander verschieden sein können.

Die Zahl der Typhus-Erkrankungen, welche nach den Gesetzen bei dem staatlichen Medicinalbeamten von den Aertzten gemeldet werden müssen, betrug in Altona: 1890—im Februar 26, März 34, April 30, Mai 28, Juni 24, Juli 24, August 13, September 27, Oktober 32, November 32, Dezember 56; 1891—Januar 107, Februar 412, März 137, April 68, Mai 25, Juni 21; während der Grundwasserstand zu Anfang August zu + 6·47, am 20. Oktober zu + 4·70, am 25. Januar zu + 4·55 Meter über Normal-Null ermittelt ist, dann aber bis Mitte März auf + 7·00 Meter stieg. Also auch hier bewährt sich die Regel Pettenkofer's, dass die Typhus frequenz, sobald die Incubationszeit berücksichtigt wird, fast genau dem Stande des Grundwassers entsprechend ist, mit dem fallenden Wasserstande steigt, bis zum niedrigsten Stande, der der höchsten Frequenz entspricht und mit dem Steigen des Grundwassers sofort wieder abnimmt; der Culminationspunkt des Typhus liegt 31 Tage hinter dem Tage, an welchem das Grundwasser seinen tiefsten Stand erreichte. Trotz dieses Zusammentreffens ist es aber doch nicht zulässig, in dem Sinken des Grundwassers ohne weiteres die Ursache der Epidemie zu suchen, denn mit Recht wäre dagegen einzuwenden, weshalb denn, da die Grundwasserverhältnisse in St. Pauli und Altona nahezu gleich sind, die Epidemie nur die Stadt Altona, nicht aber gleichzeitig die an ihr belegene Vorstadt St. Pauli ergriffen hat. Es müssen also andere Umstände gleichzeitig eingewirkt haben, wenn das Sinken des Grundwassers die Ursache der Epidemie war, oder ganz andere Umstände für diese verantwortlich gemacht werden. Es liegt ausserordentlich nahe und ist vor allem sehr bequem, auch in dem vorliegenden Falle das Wasser zum Träger und Verbreiter der Epidemie zu machen, man braucht nur "bewährten Vorbildern" zu folgen, auch wenn es diesen nicht gelungen ist, den Beweis für ihre Behauptungen zu erbringen. Thatsächlich bildet die Grenze der beiden Städte auch die Begrenzung der Epidemie und der Wasserversorgungen, wobei es vernachlässigt werden mag, dass die Aktien-Brauerei in St. Pauli ihr Wasser von der Altonaer Leitung bezieht und trotzdem weder bei ihren Angestellten noch bei ihren zahlreichen Abnehmern, welche das mit diesem Wasser in beträchtlichem Maasse in Berührung gebrachte Bier consumirt haben, Erkrankungen zu beklagen gehabt hat. Die auf


1890.
JULI
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
JANUAR
FEBRUAR
MÄRZ
APRIL
1891.
mm
30
20
10
Atmosph. Niederschläge.
7 m
6 m
5 m
4 m
Grundwasserstände in Sinnebittel über Normal Null
10
Typhuserkrankungen in Altona pro Woche auf 10000 Einwohner.
200
100
0
Typhuserkrankungen in Altona pro Woche
+30
+20
+10
0
−10
−20
Mittlere Temperatur in Graden Cels.

dem Plane der Stadt Altona eingetragenen Erkrankungsfälle ergeben mit unzweifelhafter Sicherheit, dass die Krankheit über das ganze städtisch bebaute Gebiet vertheilt geherrscht hat, doch zeigt der Plan, dass einzelne Theile der Stadt besonders heftig betroffen, andere und zwar beträchtliche Längen bebauter Strassen ganz oder nahezu ganz verschont geblieben sind. Zu den stark betroffenen Theilen gehören diejenigen Strassen, in denen zahlreiche notorisch grundfeuchte Keller vorhanden sind, sowie die mangelhaft entwässerten Strassen des Stadttheiles Ottensen; die weniger betroffenen Theile liegen vorzugsweise auf Sanduntergrund, doch befinden sich auch auf diesem Strassen mit sehr zahlreichen Erkrankungsfällen. Es lassen sich deshalb aus der Verbreitung der Fälle über die Stadt wohl Vermuthungen, nicht aber bestimmte Schlüsse ableiten. Ausserhalb der Stadt Altona versorgt das Blankeneser Wasserwerk die Dörfer Blankenese, Dockenhuden, Nienstedten, Osdorf, Gross- und Klein-Flottbek des Kreises Pinneberg, sowie die seit kurzem zum Altonaer Stadtgebiet gezogenen Dörfer Othmarschen, Oevelgönne und Bahrenfeld. Auch in diesen Dorfschaften sind Typhusfälle vorgekommen, aber nicht allein in ihnen, sondern auch in Orten, welche zum Kreise Pinneberg gehören, aber weit von der Wasserleitung entfernt liegen. Bei dem dortigen Medicinalbeamten sind gemeldet:—

Januar 4. Woche.	Februar 1. Woche.	Februar 2. Woche.
1. Tangstedt.	2. Rellingen.	3. Haseldorf.
		4. Gr.-Flottbek.
		5. „
		6. Osdorf.
Februar 3. Woche.	Februar 4. Woche.	März 1. Woche.
7. Lurup.	11. Dockenhuden.	19. Kl.-Flottbek.
8. Haseldorf.	12. Kl.-Flottbek.	
9. Elmshorn.	13. „	
10. Schenefeld.	14. Nienstedten.	
	15. Clevendeich.	
	16. Haseldorf.	
	17. Seestermühe.	
	18. Eidelstedt.	
März 2. Woche.	März 3. Woche.	April 1. Woche.
20. Nienstedten.	21. Lurup.	25. Lurup.
	22. Sülldorf.	
	23. Blankenese.	April 2. Woche.
	24. „	20. Nienstedten.

Von diesen 26 Erkrankungen sind 14 in Orten, in denen überall gar keine Wasserleitung liegt, 5 in Orten, die theilweise Wasserleitung haben, an welchen aber die weitab wohnenden Erkrankten gar keinen Anschluss besitzen, und 7 in Häusern vorgekommen, die Wasser der Blankeneser Leitung beziehen. Von diesen Erkrankten wohnen 3 in zwei Häusern am Osdorfer Wege, in deren Kellern in jedem Jahre das Wasser fusshoch steht, sodass deren polizeiliche Räumung wegen

Unbewohnbarkeit bereits früher erwogen ist. Es ist doch gewiss auffällig, dass unter den etwa 2,400 Einwohnern des Ortes Blankenese, welche Wasserleitungswasser beziehen, kein Typhusfall vorgekommen ist, während in dem weitab liegenden nicht versorgten Theile deren zwei gemeldet sind; dass ferner in der von mehr als 300 Insassen bewohnten Osdorfer Armenanstalt kein einziger Erkrankungsfall eingetreten ist, trotzdem diese Leute doch sicher nicht besonders gut genährt und widerstandsfähig gegen Erkrankungen sind. Aehnlich ist es in den Dörfern, die jetzt zu Altona gehören: unter den 2,200 Einwohnern von Bahrenfeld sind 2 Erkrankungen vorgekommen, von denen die eine unbedingt von dem Erkrankten, einem Seemann, mitgebracht ist; in Othmarschen sind 2 Erkrankungen in zwei benachbarten Häusern, unmittelbar an dem damals fast wasserleeren Ortsteiche; in Oevelgönne ebenfalls 2 Erkrankungen vorgekommen, von denen die eine ebenfalls eingeschleppt sein soll. Aus diesen Thatsachen ist zu schliessen, dass gleichzeitig mit der heftigen Epidemie in Altona eine sehr geringe Anzahl von Erkrankungen in den dieser Stadt benachbarten Ortschaften vorgekommen, bei diesen, wegen ihrer gleichmässigen Vertheilung über die mit Wasser versorgten und nicht versorgten Ortschaften, Beziehungen zwischen der Erkrankung und dem benutzten Wasser überall nicht zu finden sind. Welche Gründe sprechen dafür, dass in Altona das Wasser der Träger und Verbreiter der Krankheit gewesen ist? Dass es dort Wirkungen hervorgerufen hat, die ihm in den Dörfern versagt blieben?

Wir müssen vor Beantwortung der Frage auf den Filtrationsprozess und die bakteriologische Untersuchung des Filtrates eingehen. Die gebräuchlichen Sandfilter werden ganz allgemein in der Weise betrieben, dass man mit möglichst kleiner Geschwindigkeit das Wasser durch die Filterschichten fliessen lässt, wobei sich auf der Oberfläche des Sandes eine Schmutzschicht bildet, die, allmählig stärker und dichter werdend, schliesslich wenig oder gar kein Wasser mehr durchlässt, sodass das Filter sich verstopft und unwirksam wird. Man hat deshalb, ehe dieser Zustand eintritt, die Filter von Zeit zu Zeit zu reinigen, was dadurch geschieht, dass die oberste etwa 20 bis 30 Millimeter starke verschmutzte Schicht abgestochen und alsdann das Filter wieder in Gebrauch genommen wird. Ein solch gereinigtes Filter arbeitet kurze Zeit bakteriologisch mangelhaft, es lässt erheblich mehr Keime durch, als ein schon in Gebrauch gewesenes, doch verliert sich dieser Mangel, je nach der Beschaffenheit des rohen Wassers, mehr oder weniger schnell. Wie lange ein Filter von einer Reinigung bis zur nächsten wirksam in Gebrauch bleiben kann, hängt von der Qualität des Rohwassers und des Sandes, sowie von der Geschwindigkeit ab, mit der filtrirt wird. Im allgemeinen dürfte ein durch thonige oder erdige Beimengungen weniger verunreinigtes Wasser die Arbeitszeit der Filter verlängern, ein stark verunreinigtes Wasser dieselbe verkürzen. Die meisten Flüsse führen während der Frostzeit klareres, weniger getrübtes Wasser, als in den warmen Monaten, in denen nach heftigen Regengüssen häufig sehr erhebliche Trübungen des Wassers eintreten. Dementsprechend können die Wasserwerke in der Regel während der

Wintermonate ihre Filter länger betreiben, als im Sommer, zumal auch fast ausnahmlos in der kalten Jahreszeit weniger Wasser gebraucht, also auch langsamer filtrirt wird, als in der warmen. Die Zeitdauer, während welcher die Filter von einer Reinigung bis zur andern benutzt werden, ist bei den Wasserwerken sehr verschieden; beispielsweise finden sich in den Angaben deutscher Wasserwerke aus dem Jahre 1889–90 folgende Zahlen:—

Berlin	längste Betriebsdauer	90	Tage,	kürzeste	8	Tage.
Breslau	„	70	„	„	13	„
Magdeburg	„	40	„	„	11	„
Altona	„	48	„	„	15	„
Stettin	„	22	„	„	6	„
Bremen	„	28	„	„	4	„
Stuttgart	„	70	„	„	11	„
Braunschweig	„	104	„	„	22	„

Die Schwankungen sind sehr beträchtlich; es scheint aber, als ob bisher niemand in einer Gebrauchsdauer von 70 bis 104 Tagen etwas Bedenkliches gefunden hat, man würde sonst doch wohl öfter gereinigt haben. Vermuthlich lässt man allerorts die Filter so lange arbeiten, als sie bei mässiger Geschwindigkeit und ohne übermässige Druckhöhe zu filtern in Stande sind. Auch bei den Blankeneser Werken ist nach diesem Grundsatze filtrirt, und so treffen hier, wie wohl an allen anderen Orten, die längsten Arbeitszeiten immer in den Winter, weil bei Frost das Elbwasser regelmässig sehr wenig verunreinigt ist. Wie lange ein jedes der 10 in Blankenese vorhandenen Filter von einer Reinigung bis zur andern gearbeitet hat, zeigt die anhängende graphische Darstellung, in welcher jedesmal am Tage der Reinigung die Filterdauer auf den Nullpunkt zurückgeht, und von diesem aus regelmässig bis zum nächsten Reinigungstage wieder ansteigt, sodass aus den dargestellten Linien die Arbeitsdauer der Filter direkt abzulesen ist. Unter diesem Diagramm steht ein ferneres, welches den Durchschnitt der Arbeitszeit aller 10 Filter für jeden Tag anzeigt. Die Figur ergiebt, dass während der Monate Juli 1890 bis April 1891 die Arbeitszeit von 50 und mehr Tagen nur 10 mal, von 40 und mehr Tagen nur 11 mal, die längste Arbeitszeit von 59 Tagen zweimal erreicht ist, während die durchschnittliche Arbeitszeit etwa 15 bis 20 Tage beträgt. Es ist also bei den Blankeneser Werken die in andern Wasserwerken gebräuchliche längste Arbeitszeit der Filter von 70 bis 104 Tagen lange nicht erreicht. Trotzdem aber stieg, als während des sehr kalten Monates Januar dieses Jahres die Arbeitsdauer der Filter von durchschnittlich 20 Tagen auf durchschnittlich 33 Tage verlängert wurde, der durch die bakteriologischen Untersuchungen ermittelte Gehalt an entwickelungsfähigen Keimen ganz ausserordentlich hoch, indem an Stelle der sonst gezählten stets unter 100 bleibenden Anzahl nunmehr plötzlich 1,100 and 1,900, im Durchschnitt 1,500 Keime im Cubikcentimeter Wasser gefunden wurden. Dieser Befund veranlasste, schleunigst einige Filter zu reinigen, und kaum war dies bei der Hälfte der Filter geschehen, so sank die Keimzahl sofort

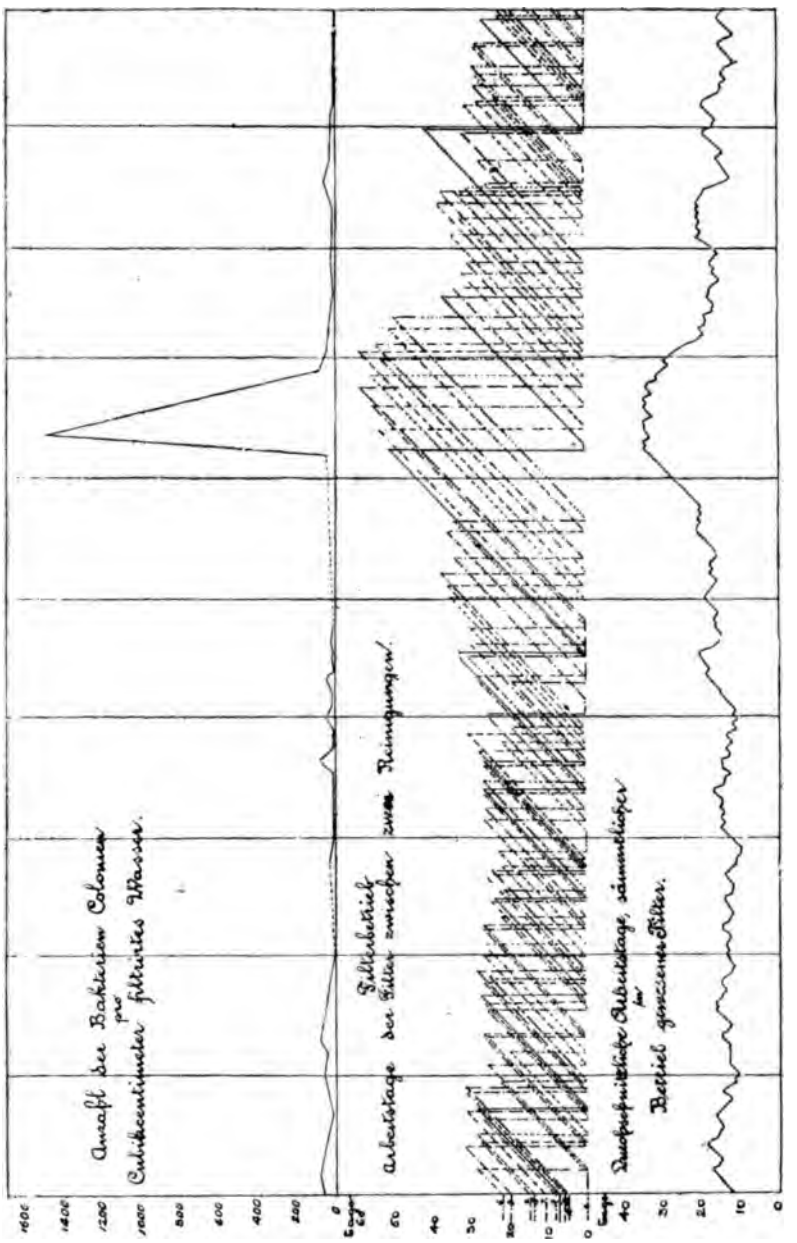


PLATE II.

wieder auf das gewöhnliche Maass, und blieb auf und unter diesem für die ganze fernere Beobachtungszeit bis heute. Es entspricht diese explosionsartige Vermehrung der Keime in ihrem Anfange genau dem Anfange der längeren Arbeitsdauer, während ihr Ende der verminderten Arbeitsdauer etwas voraufeilt. Ist dieses Vorkommen ein zufälliges oder sind ähnliche Beobachtungen auch andrerorts gemacht? In der Litteratur ist nichts darüber zu finden, wohl aber ist es auffällig, dass die

auch bei andern Wasserwerken beobachtete explosionsartige Zunahme der Keime im filtrirten Wasser ebenfalls mehrfach in die Wintermonate fällt, z. B. in Stralau-Berlin mit 2,300 Keimen auf den 30. März 1886, in Tegel-Berlin mit 1,500 Keimen auf den 8. Dezember 1885, in Warschau mit 406 auf den 9. Februar 1889 und auch hier schon einmal mit 1,150 Keimen auf den 20. Februar 1886, als die durchschnittliche Arbeitsdauer der Filter 40 Tage betrug. Ein einzelner Fall, sogar zwei gleichartige Beobachtungen sind nicht ausreichend, um eine Regel zu begründen, wohl aber können sie veranlassen, Untersuchungen nach der angegebenen Richtung anzustellen und dadurch möglicherweise den Grund der ebenso plötzlichen Vermehrung wie Abnahme zu ermitteln. Hier angestellte Versuchsreihen während der Monate Juni-August 1890, bei denen ein dem Grossfilter genau gleiches Versuchsfilter benutzt wurde, ergaben am 24. Arbeitstage bei 300 mm. Filtrirgeschwindigkeit 196 Keime, am 26. Tage bei 82 mm. Geschwindigkeit 210 Keime und am 31. Tage bei 225 mm. Geschwindigkeit 190 Keime; ein zweiter Versuch, nach geschehener Reinigung des Filters, nach dem 1. Arbeitstage bei 83 mm. Geschwindigkeit 84 Keime, am 11. Tage bei 50 mm. Geschwindigkeit 408 Keime, am 21. Tage bei 59 mm. Geschwindigkeit 8 Keime und am 48. Tage bei nicht genau ermittelter aber ebenfalls sehr geringer Geschwindigkeit 420 Keime. Diese beiden Versuchsreihen gaben kein brauchbares Resultat; wir sind durch fernere Versuche, weitere Aufklärung zu finden bemüht, und zwar, weil bei den ersten Versuchsreihen das rohe Wasser mit seinem sehr schwankenden Keimgehalt die Ergebnisse beeinflussen konnte, jezt mit 3 ganz gleich eingerichteten Versuchsfiltern gleichzeitig mit verschiedenen Geschwindigkeiten und verschiedenen Arbeitszeiten, bei denen die Wirkung dieser beiden Faktoren ohne Störung durch Nebenumstände zur Erscheinung kommen muss.

Die graphische Darstellung der bakteriologischen Ergebnisse zeigt unzweifelhaft, dass der Keimgehalt des filtrirten Wassers stets erheblich unter derjenigen Grenze bleibt, 300 Keime, welche die Wissenschaft jetzt bei filtrirtem Flusswasser für zulässig erklärt, ja weit unter der Grenze, 100 Keime, welche Professor Dr. Gärtner als bei einer gut eingerichteten und funktionirenden Sandfiltration für sicher erreichbar erklärt. Aber es ist nicht in Abrede zu stellen, dass während des Monates Januar plötzlich eine erhebliche Steigerung des Keimgehaltes weit über die Grenze hinaus eintrat, wenn diese auch durchaus noch nicht die Höhe erreichte, welche bei andern Werken beobachtet ist. Unglücklicherweise liegt diese hohe Keimzahl unmittelbar vor der Epidemie, 33 Tage vor der höchsten Typhusfrequenz, und ist deshalb sehr geeignet, den Anhängern der Wasserverbreitungstheorie als Beweis für die Richtigkeit ihrer Behauptung zu dienen, da ihnen andere Beweise vollständig fehlen. Es war uns bekannt, dass schon zu Ende Dezember die Zahl der Typhusfälle sich vermehrt hatte, und gab dies Veranlassung, sowohl hier wie in Kiel die Untersuchungen, insbesondere die Bestimmung der Arten mit ganz besonderer Sorgfalt auszuführen. In allen Proben sind nur die stets im Elbwasser vorkommenden Arten unschädlicher Wasserbakterien gefunden: Bacillus implexus, B. lique-

faciens, B. fluorescens liquefaciens, B. fulvus agilis, B. albus, B. aurantiacus, B. plicatus, B. candicans, Mikrococcus sulfureus, mehrere weisse, eine rothe Hefeart, von denen je 3 bis 9 Arten in jeder Probe zu finden sind. Im Januar traten einzelne der verflüssigenden Arten ganz besonders zahlreich auf; andere Arten, insbesondere pathogene, sind niemals gefunden, trotz der zahlreichen Proben, welche untersucht sind. Nun ist ja das Nichtfinden krankheitserregender Keime durchaus kein Beweis dafür, dass in dem Wasser keine Typhusbacillen enthalten gewesen sind, aber bis zu geschehenem Nachweis ist die Behauptung, dass sie vorhanden gewesen sein müssen, doch um nichts begründeter, als die vom Gegentheil; während uns doch wenigstens das redliche Bemühen nicht abzustreiten ist, das Unsrige zur Aufklärung des Sachverhaltes gethan zu haben, begnügte man sich anderntheils nichts zu thun, jetzt aber um so kräftiger seine Ueberzeugung als zweifellose Thatsache hinzustellen.

Bei einer unbefangenen Prüfung der Umstände, welche in den vorstehenden Darlegungen, sowie in den angefügten graphischen Darstellungen enthalten sind, erscheint es kaum zweifelhaft, dass Altona durch die mancherlei sanitären Massregeln, welche hier in den letzten Jahren getroffen sind, jahrelanger Verunreinigung des Untergrundes durch Abgänge des menschlichen Haushaltes ein Ende gemacht hat; dass durch diese Massregeln eine wesentliche Austrocknung des Untergrundes, dadurch aber auch eine verstärkte Verwesung der Verunreinigungen und hierdurch weiter eine Vorbedingung geschaffen ist, welche bei dem Zusammentreffen ungünstiger Umstände die gewöhnlichen leichten Erkrankungsfälle bis zu einer vollständigen Epidemie steigern konnte. Als solche ungünstige Umstände sind das tiefe Sinken des Grundwassers, möglicherweise auch der hohe Keimgehalt des Wassers zu bezeichnen, welcher, wenn auch an sich nicht schädlich—das beweisen Hamburg mit seinem weit über 3,000 Keimen haltenden Wasser und die Dorfschaften an der Elbe—doch schädlich wirken konnte bei dem an sich schon für die Aufnahme der Krankheit vorbereiteten Zustande der Stadt Altona und ihrer Bewohner. Bei Hamburg fehlten diese besonderen Umstände, dort war das Reinigen des Untergrundes schon viel früher zur Wirkung gekommen und hatte sich in den Epidemien von 1886 und 1888 die gleiche Erscheinung gezeigt, welche hier in diesem Jahre zu Tage trat, und in fast allen anderen Städten beobachtet ist, sobald nach Ausführung der gründlichen Bodenreinigung die Umstände das Ausbrechen einer Epidemie begünstigten. Deshalb hat Altona eine Typhusepidemie durchmachen müssen, von der Hamburg völlig verschont blieb, weil hier das fehlte, was zu den übrigen Bedingungen hinzukommen musste, um die Epidemie zum Ausbruch zu bringen.

Der greise Meister der deutschen hygienischen Wissenschaft, Dr. Max von Pettenkofer, dem die vorstehenden Thatsachen zur Kenntniss gebracht wurden, schreibt:—

"Ich stehe ganz auf Ihrem Standpunkte, dass die Epidemie nicht vom Trinkwasser abzuleiten ist. Die Altonaer Epidemie erinnert mich sehr an hiesige Erlebnisse. Auch München hatte, solange es noch Typhusboden war, die grösste Morbidität und Mortalität

im Winter, wo die Menschen am wenigsten Wasser trinken, wo wir allerdings auch den tiefsten Grundwasserstand hatten.

"Seit unser Boden allmählig reiner wurde, theils durch Reinerhaltung, theils durch Selbstreinigung, wurden die Epidemien immer schwächer und haben wir seit 11 Jahren keine mehr gehabt. In früheren Jahren schwankte die jährliche Typhussterblichkeit pro 100,000 Einwohner zwischen 150 und 330, jetzt zwischen 10 und 12, obschon der Grundwasserstand noch ebenso auf- und abschwankt, wie früher. Jetzt thut uns ein tiefer Grundwasserstand kein Leid mehr an; das kann auch die Ursache sein, warum der Typhus in Hamburg 1891 trotz unfiltrirten Wassers nicht aufgetreten ist, während er in Altona trotz filtrirten Wassers auftrat, obschon der Grundwasserstand für Altona und Hamburg der gleiche war.

"Wenn Sie in Altona so lange mit Assanirung des Bodens fortfahren, wie in Hamburg, wird Ihnen ebenso wie in München auch bei tiefem Grundwasserstand und vielen Bakterien im Trinkwasser der Typhus nichts mehr anhaben.

"Ich weiss recht wohl, dass diese meine Ansicht vom Einfluss des Bodens nicht harmonirt mit den gegenwärtig herrschenden theoretischen bakteriologischen Anschauungen, und dass ich nicht angeben kann, was alles speciell vom Boden dazu gehört um eine Typhus-Epidemie hervorzurufen, aber ich bin nicht schlimmer daran, als meine Gegner, welche eine Epidemie durch Trinkwasser erklären, ohne Typhusbazillen darin nachweisen zu können."

Bei der grossen Erfahrung Pettenkofer's ist seine Meinung um so werthvoller, als ein sicherer Beweis weder für die eine, noch für die andere Behauptung zu führen ist. Jedenfalls zeigen diese Mittheilungen, dass im Filtrationsbetriebe noch immer Räthsel zu lösen sind, und die bakterioskopische Untersuchung des filtrirten Wassers viel regelmässiger und sorgfältiger geschehen sollte, als dies im Allgemeinen üblich ist.

The Water Supply of India.

BY

Brigade Surgeon R. Pringle, M.D., Edinburgh, late Sanitary Department, Her Majesty's Bengal Army.

The vast importance of the general subject of the water-supply is so fully admitted in the present day that no outlay is deemed extravagant or excessive when the object of it is to secure this first necessity of sanitation. When cities such as Glasgow, Liverpool, &c., in search of this source of health, enter on schemes such as that completed for Glasgow, and that now being carried out for Liverpool, the extent and

cost of which it is difficult to realise, it is yet felt that on this one important point a primary judicious liberal outlay is, in the end, the most economical; and perhaps nowhere is this more evident than in the case of cities like Glasgow, Cardiff, Liverpool, &c., which are also large seaports, and where the value of a really good water supply can never be over-estimated, as it is greatly to be feared that much of the sickness experienced on board ship is due, not a little, to the inferior quality of the water taken in at the port of departure being such as to make it unfit for storage.

If all this is necessary in this country, how much more is it so in India, with its population, practically total-abstaining, proverbially like their sacred cows indifferent either to the source or quality of their drinking water, so dense and so migratory. And yet, if the question were asked, What has been done in the matter of the water-supply of India? up to within the last 10 years I fear the answer must be, Practically nothing. True, within these 10 years considerable efforts have been made to improve the water supply of large cities, such as Calcutta, Bombay, &c., but the population of India is not to be found in the cities; ·95 per cent. of the people of India are in the villages, and what, I ask, has been done for them? And again the answer is, Nothing, if I may judge from an experience as extensive as that enjoyed by most medical officers of 30 years' Indian service. Take, for instance, the densely populated districts of the upper portion of the Mesopotamia, of the Ganges and Jumna, as embraced in the Agra and Meerut Divisions; or the first sanitary circle of the North-Western Provinces, with a population of over 10,000,000, crowded together to the extent of over 500 to the square mile. For 20 years continuously I was in the sanitary charge of this circle from 1864, and I can vouch for it that nothing has been done by the Sanitary Department with the Government of India during that time to improve the water supply of this circle, and I challenge them to say that it is due to my neglect in failing to bring the subject before them. My annual sanitary reports will answer this, and will further show that the remedies I proposed were not such as would involve a large outlay, but were cheap, simple, and permanent. Not only has nothing been done for the fixed population of these districts, but that most important section, as regards the public health of the community, I mean the migratory and pilgrim population, has also been left worse than unprovided for in the matter of its water supply, as wells which should be closed are left open to tempt the thirsty traveller to his fate, and a regiment on the line of march, when halting for its early breakfast, as I know, ran a great risk of having the seeds of typhoid fever taken up from one of these wells containing, not only stagnant water, but water charged with malarial germs. Through the whole length of this district pass tens of thousands on their way to and from the sacred shrines of Muttra, Bindrabun, &c., and places of pilgrimage on the Ganges and Jumna, from Hurdwar to Allahabad on the former, and from Kalsi (where the Jumna leaves the Himalayas) to the union of the latter with the former, at "Pryag" or Allahabad. The condition of the water in the wells

and their surroundings are a disgrace to sanitation from the "Meeta Kooah," the sweet well at Agra, to the filthy well near the sacred steps at Hurdwar. The same, alas, is the case with the wells on the line of railway, with stations such as Etawah, Toondlah, Agra, Gazeeabad, and Saharanpur. Can it, therefore, be a matter of surprise to hear that that country is decimated by sickness, in a great measure preventable. To sum up this terrible account, I have seen the water in the railway well at Saharanpur fouled by "lotahs" (the brass drinking cups a native carries over his shoulder with a cord) covered with unutterable impurities during an epidemic of cholera, and a regiment passed through the station under these conditions. I can point to roadside and encampment wells in which the water was impure from stagnation, and the imperfect way in which the well was emptied in the case of troops coming to encamp on the spot, by which the impurities adhering to the sides of the well were left to be again mixed with the water as it rose in the well. It is from sources such as these that typhoid fever enters the large military cantonments, where, from the defective water supply, it soon spreads, and an unaccountable (?) outbreak of typhoid is the result.

The water-supply of the plains of India, as met with in the Bengal Presidency, may be classed (that from artesian wells being still under trial) under three heads, viz., Well, River, and Tank or Pond water.

Well-water.—The quality of the water from this source varies greatly, from the perfect supply, obtained by the presence of a faultless masonry tube, which brings the water to the surface after a *compulsory filtration*, through suitable soils, where by constant emptying and refilling and the absence of several feet of leaf mould at the foot of the well, owing to the well being covered, the water is, for all practical purposes, as perfect as can be obtained in the plains of India, to the filthy water obtained from wells which are but slightly removed in the rains from cesspools, as is the case with some of the servants' wells in the officers' compounds in the cantonment of Meerut. Between these two extremes as regards quality the well water of the plains of India ranges.

The ideal well I have described is, I fear, far from common in all the conditions necessary to secure a good water-supply; and there is little doubt that the drinking water for the vast majority of the peoples of India, as far as it relates to well-water, is obtained from the most defective system of wells; and it is because I feel that the real sanitary improvement of India must begin at the well, that I have asked to be allowed to draw special attention to it.

Let me start with the village well, or that from which nine-tenths of the population of India draw their drinking water. This is nearly always "kutcha," *i.e.*, dug out of the soil, without any masonry tube, the home, too often, of pigeons and other birds, as a protection from cats and snakes, with but rarely any parapet, and generally a "peepul" (sacred fig) tree over it, whose dead leaves have produced a layer of leaf mould, it may be two or more feet thick, rarely cleaned out except when something valuable falls into the well. Can it be wondered at

that malarial germs suspended in this water, and forced through this mould by spring-water-power, are freely drunk by these villagers, to say nothing of the impurities washed in owing to the absence of a parapet, or the young birds falling in from their nests. There is only one source of impurity from which these "kutcha" wells are free, and which in "pucca" or masonry wells is often the cause of the water becoming unfit for drinking purposes; I allude to frogs. These animals, if they have nothing to rest on or hold on to in the well, not infrequently die. In a "kutcha" well they manage to rest in little holes in the sides, but in a "pucca" one the natives always throw in some "bajra" or millet stalks when they see there are frogs in a masonry well, and nothing on which they can rest. In most villages there are generally one or more masonry wells, but the surroundings, as I shall point out, are such as seriously to interefere with the purity of the water. These wells however, are in the enclosures of the head man of the village, and are, therefore, not available to all. There is always a tree shading these wells, and, unless the masonry sides are in good condition, the impurities of the courtyard too often find their way, little changed, into the water in the well by means of the roots of the tree and cracks in the masonry. Near this well often is a most insanitary institution known as a "chawbatcha," which is simply an open receptacle for all kinds of surface impurities, and as this is frequently near the verandah, we cease to wonder how it is possible to become quite indifferent to that which would upset most people. Not a few of these wells are so constructed that a passer-by can dip in his "lotah" and draw up water, but after what I have said of the too frequent state of this "lotah," this must be a dangerous proceeding to the health of the household. In short, it seems almost hopeless under present conditions for the water in a town or city well to be pure, unless situated within an enclosure; but here a fresh difficulty arises, water in India under the ordinary conditions met with in even a fairly good masonry well, cannot remain pure unless regularly withdrawn, and as this is impossible in the case of a large well and a small household, the result too often is that a species of typho-malarial fever breaks out; it may be confined to a house or two, but if the season is unusually dry, the disease sometimes becomes alarmingly epidemic, as happened once at Haupper in the Meerut district. The remedy for this lies in using the water for irrigating the garden, and if this is impracticable then in obtaining drinking water from a well constantly in use.

River-water.—In the plains of India, when we think how little makes a river even temporarily sacred, viz., by its running southward, and when this is the case how it becomes the highway to heaven for the mortal remains of all who can secure this last religious act being performed, I think it requires very little sanitary knowledge to decide that, with but very rare exceptions, it is, unless a most elaborate and careful system of purification is secured, a most hazardous proceeding to use river water in India for a drinking-water supply; and nothing would induce me to use it for this purpose without boiling it first.

Tank or pond water.—This is open, if possible, to greater objections than the river water-supply, because there is no real change taking

place in the water, and if bodies are not thrown into it, here is little doubt that many corresponding impurities find their way into these ponds. Some species of water plants are credited in Bengal with purifying the water of ponds; possibly they may, but I prefer 212° Fahr.

Filters at railway stations as a means of purifying the water require so much looking after, that I prefer the plan recommended hereafter. The filter at the cantonment railway station at Meerut, when I once inspected it by lifting off the cover, only required the regimental band to convert it into an object for an aquarium, and if this happened at Meerut, what may we not expect at smaller stations.

In some parts of India, where the water-supply is apt to become very impure from the heavy rains, the rain-water is collected and carefully stored in large jars. The mode of this collection is as effective as it is simple, viz., by means of a very large cotton sheet, tied at the four corners to poles, about four feet high, and to secure the collection of all the rainfall a smooth clean stone is thrown on the sheet, and as it rolls into the centre and remains there, the water gathers here, and passes into the collecting jar below. This, when full, is taken away and emptied into the large storage jars; thus, a supply of very pure water is obtained, and when carefully stored in a cool place, is no doubt in many districts very valuable.

After this practically universal condemnation of all the ordinary sources of the water supply, as at present met with in India, the least I can do is to recommend some measures for securing a good water supply, if such are practicable; and fortunately they are not only practicable, but simple and feasible. During my entire Indian service the improvement of the water-supply was my constant endeavour, and with, I trust, justifiable pride and satisfaction I can point to that at the hill sanatorium of Mussooree in the Himalayas, as the crowning of all my labours, for here is a water-supply, perennial and incapable of pollution, delivered at three different parts of the sanatorium, and all attained without the addition of a penny to the amount of the local taxation. This entire scheme was carried out quite independently of the Sanitary Department with the Government of India, for, as an elected not officially nominated member of the Municipality of Mussooree, I designed and superintended the whole scheme; and to this municipality is due the entire credit of having a water-supply unequalled in any other station in India, on the hills or in the plains, at an entire cost of Rs. 30,000, or about 3,000*l.*, spread over six years.

At my first station in Orissa, in 1855, by using the ordinary baked clay rings, I sunk new wells where I found the locality of the old ones defective; and when I came to the North-Western Provinces in the special Sanitary Department, I saw from some cases of typhoid fever at Mussooree the absolute necessity of a good water-supply, and that scheme just alluded to was the outcome of these cases of typhoid fever. When marching through the first sanitary circle in 1864, I saw the condition in which the supply of drinking water for the troops on that line of march and for the weary traveller or pilgrim was in the roadside wells, and in those in the encamping grounds, and after various trials and experi-

ments, decided on one which seemed cheap, simple, and effective. When the railway system spread through my circle, I felt that, unless some steps were taken, the water at the railway stations would prove a serious source of danger to the public health, and accordingly I suggested the following measures for remedying the defects complained of.

First.—Roadside wells. In my circle there were about 200 of the "cos kooahs," or two-mile wells, and the simple plan I suggested was to let out these wells to the cultivators of the fields near, on the single condition that the water, before it passed into the irrigation channels, should fill a trough for the cattle, and also admit of a lotah being filled as the water came fresh from the well. Where this was carried out, it answered admirably, and cost the Government nothing; but the Sanitary Department paid no attention to the suggestion at the time, and who can tell how much of the present typhoid prevalence in the North-Western Provinces and Oudh is due to this indifference?

Second.—Wells in encamping grounds. My suggestions, similar to the above, were carried out by some magistrates, and appeared to work so well that one wonders how the system was not universally adopted. While on the subject of water-supply when in camp, I think my experience of this is as varied and extensive as that of most medical officers, and perhaps the following may prove useful. As a rule, when in camp, I generally obtained my drinking water from an irrigation well *at a distance from* the village, preferring this to the water from the well in the encampment. From these irrigation wells the water was not only fresh and cool, but remarkably free from impurities, as these are drawn into the large bag by which the water is lifted, and thus, after the withdrawal of a few bags of water, *the surface impurities* blown into the well were removed. Further, in these wells there is no layer of leaf-mould, as the means taken to keep the well deep enough for irrigation purposes effectually remove this injurious deposit. However, as a rule, except I was quite sure of the water, I invariably boiled it, and cooled and re-aërated it by pouring it from one vessel into another.

Railway Station Wells.—When we think how largely the railways are now used, not only for travelling, but for purposes of performing a pilgrimage, and how dependent the locked in passengers are on the water supplied to them by the water-men at every railway station in India, thanks to the wise forethought of that Solon of Indian Viceroys, the late Lord Dalhousie the importance of procuring pure water and of securing this purity will be self-evident; but if I may judge from the state of this public water-supply in my late sanitary circle nothing could be more disgraceful. True, I made suggestions on this subject, but they were unheeded, and for all I know to the contrary the railway station wells in this year's (1891) "Khoomb," or twelfth year festival at Hurdwar, may be in the same state they were in in 1879; and if water can contain in suspension the cholera germs, then I should think the railway wells at Saharanpur, Gazeabad, Toondla, and Agra have much to answer for. My suggestion was to cover the wells, and use a pump on them; or, better still, when the water was being drawn up to the "Williams" towers of defence for

filling the engines, to let a large tank be filled, and *two* taps attached to this will, as I know, meet all requirements, and overcome all difficulties about caste, &c., as I proved at Mussooree.

Cantonment wells should have no trees over-shadowing them, and should have thatch covers, as all these wells once had at Meerut. All wells should be carefully examined, and those in which the water cannot be kept pure and good should be closed. The wells for the servants should receive the same attention as those used for the master, as, without doubt, if the truth were known, the water is often very indiscriminately drawn and served out. The locality of the latrine should be more carefully selected with reference to the servants' wells, and the Meerut cantonment is a very serious offender under this head.

City wells.—Favourite wells, such as the "Meeta Kooah" at Agra, should be carefully protected, and a pump used to raise the water. The "lotah," in its first dip into the well is generally very dirty, and, in bringing up water for its own cleansing, fouls that from which it is drawn.

There is, however, in nearly every Indian well one great source of impurity more overlooked than anything I know of, and that is what I have alluded to before as *the leaf-mould deposit* at the foot of the wells. Now this deposit is the very substance in which is generated the germ which is credited with the production of malarial fever, viz., the product of decomposing vegetation, chiefly of leaves. The germs in this deposit when acted on by a tropical sun, pass into the air with the fluids raised by evaporation, or, as in this case, when suspended in the water, are taken into the system, when the water of wells with a deep layer of this deposit is used for drinking purposes. To anyone who has watched the cleaning of a well with the object of bringing up something which may have fallen into it, the true character of this deposit is clearly evident; and it seems to me that, in a masonry well with a good tube, every drop of water withdrawn from the well *must* have passed through this layer of leaf-mould, and in its passage must surely bring away some of the malarial germs present in this decomposing vegetation. Indeed, I believe that of the two great trains of symptoms in true malarial fever, one, a hot dry skin, relieved by a free perspiration, is due to the malarial poison, whatever it may be, having been inhaled; while the second, a sensation of cold, with an intense desire to be sick but inability to vomit, is due to this germ having been taken into the system when suspended in water which has been drunk, in much the same way that the train of symptoms differ in spontaneous and in inoculated small-pox. In spontaneous small-pox the eruption is, in many cases, present not only internally on the various mucous membranes, but also externally; this is doubtless due to the inoculation by the virus, both as suspended in the air and breathed, and in the food or water taken into the stomach. Now, when the virus is scientifically inoculated, as practised till lately in the Himalayas, where I studied it, no general eruption appears at all, everything is confined to the site of the small-pox virus insertion; on the other hand, when this inoculation is carelessly, or, rather, unscientifically practised, and small-pox crusts are swallowed as pills mixed with flour

and coarse sugar, or these crusts in a very fine dry powder are blown into the nostrils, and thus inhaled, then the most serious results follow, the mortality is very high, and the eruption often confluent.

Now, as the native method of cleaning a well is not only expensive but very ineffective, hearing of Bull's dredger, I called on Mr. Bull when passing through Cawnpur in 1879, and at once saw that his dredger was the very thing I wanted to remove this deposit and to work down to the clean sand. I accordingly made a special report to the Government on the subject, and suggested a plan by which a Bull's dredger, placed on wheels, with a set of shears for working it, could be used in a group of stations, and transported by bullocks or horses from one station to another, in much the same way that a portable engine is made available in this country; but no notice whatever was taken of the suggestion, and I have little doubt that an examination of the deposit in the wells in most Indian cantonments, and particularly at Lucknow, would reveal conditions of insanitation which would raise the question, not why so many suffer from fever, but how it is that any escape.

When writing on the subject of the late alarming increase of enteric fever in India, I found on inquiry that the cost of a Bull's dredger, such as I have described, would be in India, complete with derrick, windlass, and 100 feet of chain, suitable for conveyance in a cart, and capable of erection in 15 minutes, 180 rupees.

And now I have done, and in conclusion would only repeat that everything here stated or suggested is to be found in my official sanitary reports for the first circle North-West Provinces, extending over 20 years, from 1864; and I can only state that, as regards this circle, with its large military cantonments in the plains, and its hill sanatoria in the Himalayas, the conclusion arrived at by the Sanitary Department in India, and in this country, to the effect that the value of the European soldier's life has greatly increased, owing to the improved sanitation of his surroundings, is just one of those delusions which, like a pricked air-bag, collapse before the sharp point of any careful inquiry.

The increased value of the soldier's life is due to a moral, not a physical sanitation, and total abstinence and its accompaniments have had more to do with this than all the sanitation which India has seen for the last 25 years. Take, for instance, the sanitary condition of the first circle as regards the work of the strictly sanitary department; it was worse in 1884 than it was in 1864, as I am prepared to prove, for the defects of 1864 were allowed to go on unheeded and unremedied till 1884, when a wide-spread epidemic of typhoid fever was the penalty of years of the grossest violation of the first principles of sanitation in the matter of the water-supply; and the cases of typhoid fever in the large hill sanatorium of Chuckrata in the Himalayas, and the increasing unhealthiness of Roorki, Meerut, Muttra, and Agra are evidences that neglected sanitation in the point of water-supply must bring a terrible retribution.

DISCUSSION.

Mons. Maignen said that Mr. Kümmel had been asked to explain the reason for the sudden rise shown in his diagram, and he had explained that it was intended to represent what he termed a sudden explosion of microbes, owing to the filter having been overworked. The same sort of thing had happened in England in the case of sand-filtration. Berlin engineers had found that sand was not capable of arresting a microbic organism until it was ripe, that was, in fact, not until a sufficient quantity of sediment had been deposited on the fine sand to form a filter in itself. What would become of the microbic organisms that had passed through that thick layer of sand before the filter became ripe? There was really plenty of room for them to remain where they were, and they would never be removed. Therefore, sand-filtration was open to great question, and they had in the case of Hamburg an explanation of why, at one particular moment, sand-filtration might bring about the evils of which they complained. With regard to boiling water, they had been told in a previous discussion that water might be considered to be safe if it was boiled at 130° C. for 10 minutes in a closed vessel. There was one point he wished to suggest, and that was that the longer the water was boiled, the more quickly would it become putrid. Water boiled for five minutes would become putrid in three days, but water boiled for a quarter-of-an-hour would become putrid in one day. He wished to say a word on the question as to what was to be done under the present emergency. In the first place, water coming from the best of sand-beds was a little coloured. This colouring was due to fine particles, so that it showed that the filtration was not perfect. But water contained other things, and they had been told that, besides sediments in suspension, there was also organic matter in solution. In some waters there was too much life. For the future they would have to deal with water, not by means of filters—which left behind things which might be a source of danger—but water must be treated chemically. He would tell them half a secret which would not be a secret next year, namely, that for the last year in Paris experiments had been made, which he was not yet authorised to divulge, which showed that the chemical purification of water entailed a bacteriological purification. He could not divulge it at present because it was necessary to find out how this was taking place, at what particular point, and for what particular reasons; but the fact was that water which had been thus chemically purified had not a living germ in it. He had seen this done in four or five laboratories in Paris, and it was found that the water was completely sterile if properly treated by chemistry. The re-agents employed were no source of danger, and they completely precipitated lime, organic matter, and organisms. He believed that this would be the treatment applied to the impure water of the future.

Dr. Simpson (Calcutta) said the last speaker on the subject had laid great stress on the purification of water; but he himself looked at it from a different point of view, and thought they should see that the water was not contaminated, and therefore would not need purification. Dr. Pringle had told them the condition of the water-supply in India, and had shown that there was some difficulty in keeping that water pure, especially when the water was collected in tanks. Quite recently, some of the gentlemen connected with the Sanitary Department in Bengal had got over that difficulty, in a way, by using tube wells. They had introduced a number

of tube wells, such as were used in the Abyssinian Expedition, and put them down near the tanks, and in that way were enabled to obtain pure water. He quite agreed with Dr. Pringle that the sanitary condition of India in regard to the water-supply was the most pressing need. He had had an illustration of that last February, when, owing to a very large festival where the people collected on the Ganges for bathing purposes, outbreaks of cholera had taken place. When those pilgrims went home they took the cholera to their villages; and, following them up, he had inquired into the matter, and found that wherever pilgrims went and polluted the water-supplies (which they did so easily, as Dr. Pringle had told them), there cholera broke out, so that there were epidemics all over the country, which he attributed entirely to the water-supply. In another Section he had mentioned what had occurred in Calcutta on the introduction of the water-supply, and he thought it was a fact worth repeating. In Calcutta the water-supply was introduced at the end of 1869. In the five years prior to that date there were 21,000 deaths from cholera; in the five years after the water-supply was introduced, there were 5,000 deaths. Now, the supply at first was a street supply—standposts were introduced at certain distances along the streets and lanes. The people soon began to see the value of water, and were clamorous for the introduction of that water-supply into their houses. A number of house connexions were made, and the consequence was that in a very short time the street supply, instead of being constant, became intermittent. The cholera death-rate immediately ran up, and in the next five years, instead of an average of 1,100 deaths a year, the average was 1,400. That matter was not remedied; a great deal of controversy went on, and another five years passed away without any remedy. The consequence was that more house connexions were made, the water was allowed to go to waste, and in certain sections became so scarce that it was almost impossible to get any. The result in those five years was that the deaths from cholera further rose from 1,400 to an annual average of 1,800. Then a partial remedy came in, more water was brought, but it was not so well distributed until the last year of the last quinquennium. The intermittency was not done away with, but the supply was better. The cholera death-rate immediately ran down again to 1,400. During the past two years the supply, though still intermittent, had been very much improved, and the cholera mortality had fallen to 1,000. After his experience in India, from the inquiry into local outbreaks and from the knowledge of what had occurred as the result of sanitary measures in regard to water-supply, he was convinced that once Calcutta, which was called the home of cholera, had a constant water-supply as well distributed as in some of the English towns, there would be no cholera excepting that which was imported from the villages, From that illustration they would see the importance of the water-supply to villages. Ninety-five per cent. of the population of India lived in villages, and it was really in the villages that so much ill-health occurred. He had mentioned cholera simply because it furnished a good illustration; but he was convinced that much of the fevers, of which they had probably heard, were due to the condition of the water that was drunk. India was such an immense country, and the people were so poor, that they could not have very large drainage works, but they could introduce a proper water-supply; there was no doubt of that, and he was sure some system of drainage could be devised by the eminent engineers who had to do with sanitary science, which would be of an inexpensive nature, and would meet the requirements of the country.

Mr. Binnie said he thought they must feel very much indebted to Dr. Pringle and Dr. Simpson for the remarks which had fallen from them on the subject of water-supply in India. That was a matter about which he had some little experience, and in which he could corroborate very fully all the statements of those gentlemen. The great bulk of India was without a water-supply in the sense in which they now used the words. Nothing could be more filthy or disgusting than the ordinary village well, and it behoved them to do what they could to improve the water-supply in that country. Of couse, in the large towns and municipalities they had to a certain extent an unlimited amount of water. Calcutta, as they had heard, was doing its best; Bombay was certainly far in advance of all the other towns in India, for not only was it getting a larger water-supply than any other town, but it was getting water from an undoubtedly pure and uncontaminated source, and from uncultivated and, he believed, unculturable areas. The importance of this they had seen in the paper on Altona. That town derived its water-supply from a river at a point below that at which sewage was discharged into it. They saw from the diagram that in that particular case the people drank the water with perfect impunity and immunity as regarded that particular outbreak of disease. At a certain period—in the month of February 1891—that disease increased at a great rate. They saw also that about the same time, or rather, in the previous month of January, the filters gave indication of a very sudden rise in the number of microbes detected. Going back another month, they saw that the month of December was one in which there had been little rainfall. Putting those things together, he thought they confirmed a remark he made the other day, that they might for a long time continue to drink comparatively clean and healthy sewage, but the time would sooner or later arrive when epidemics of that kind would break out. It was most instructive to have such facts brought before their notice in the very clear way that the diagrams did, and they had seen what had been noticed in other places, that sand-filtration was not a perfect protection against those diseases.

Herr Kümmel said he did not see how the filter could be overworked, but he had said in his paper, and repeated it now, that it was possible that there existed some relation between the working days of the filter and the number of microbes. The other things which had been mentioned were all to be read in his paper, but he wished to say that Mr. Binnie's remarks were right.

Aperçus sur l'Assainissement du Sous-sol des Villes.

BY

Señor Don Pedro Garcia Faria.

Parmi les lois qui regissent tout ce qui a été crée, une des plus notables est certainement la relative à la circulation continue de la matière, laquelle se présente à nous sous divers aspects, selon la phase que nous observons du cycle fermé où celle-ci évolutionne.

Cette loi a reçu de très importantes applications depuis le Congrès International de Bruxelles de 1856 où Mr. Ward la formula par cet

aphorisme : "Circulation or stagnation," formule savante dont l'application renferme le système complet de l'assainissement des villes. Les eaux de pluie pénètrent dans le fond bas des terres et, de là, on les achemine vers les grandes cités, et servent à l'approvisionnement, en leur assignant les divers services qu'elles sont appelées à rendre ; dégénerant bientôt en déjections urbaines extrêmement toxiques, il faut en faciliter l'éloignement par des moyens naturels ou artificiels, obligeant ces substances putrides à se purifier par l'action filtrante et régéneratrice du sol, de l'oxigène de l'air, et des végétaux, dont l'effort contribue à transformer ces substances en d'autres inertes qui, plus tard, devenues assimilables à l'homme, serviront à son alimentation.

La même circulation s'établit au sujet de l'air, dont la régénération par rapport à l'air vicié s'accomplit d'une manière analogue, et en général on peut dire que là où la vie existe, on observe la transformation de la matière.

Les procédés employés à l'assainissement des villes varient selon l'importance qu'ont ces villes. Dans les petites, l'action régénératrice des agents naturels, est réellement efficace, tandis, qu'au contraire, dans les grandes cités, cette action est si faible qu'elle est insuffisante pour combattre les multiples causes d'infection qui se présentent.

La formation des villages a lieu généralement par l'agroupation de demeures plus ou moins distantes entr'elles, qui réclament la construction de nouvelles habitations, et c'est alors que se forment des rues rudimentaires, comme rudimentaires sont aussi les services qui s'etablissent en elles. Ainsi dans la plupart des hameaux, les rues sont de véritables torrents qui deviennent le réceptacle des eaux de pluie et des eaux sales, même des ordures de toutes sortes ; mais par cela même prétant plusieurs services, ceux, en effet, d'expulser les eaux excédentes et les excreta du village.

Les résidus qu'il convient d'enlever le plus promptement possible sont les matières fécales, les plus toxiques pour l'homme, et pour que leur évacuation soit rapide, il importe d'établir des canalisations qui les transportent avec célérité en des lieux n'offrant aucun péril à la santé publique ; il conviendrait aussi évacuer en elles toutes les eaux contenant des matières organiques, en un mot, tout ce qui est susceptible de décomposition et qui peut être emporté par la véhiculation aqueuse. En faisant cela, il faut rendre convexe le profil transversal des rues, car les égouts sont destinés à remplacer le lit du torrent tracé dans les rues rudimentaires ; par lui la chaussée se perfectionne, et de naturelles separations s'etablissent entre la circulation pédestre, la roulante et la ferrée, qui peuvent encore s'exécuter souterrainement, ainsi qu'y établir les canalisations et les tuyaux de distribution.

L'assainissement des villes de peu de ressources ; celles d'exiguë population, et, enfin, celles dont les conditions topographiques ne comportent point l'installation de galeries où l'homme puisse pénétrer, s'obtient par le système tubulaire formé par des conduits cylindriques, en grés, eprouvés sous 10 atmosphères, et rendus ainsi inattaquables aux eaux sales et industrielles, dont l'évacuation a lieu par ces conduits.

Le réseau sera nettoyé au moyen d'ondes recueillies dans des reservoirs à echappées automatiques, fixées à la tête de chaque tuyau et semblables à celles que l'on emploie pour le nettoyage des égouts. En cas d'obstruction des tuyaux alimentaires des réservoirs, ou que l'obstruction du drain fût dificil à éviter, le nettoyage se pratiquera alors au moyen de baguettes flexibles introduites dans le drain principal par le secours de trois autres tuyaux mis en communication avec lui. lesquels émergent du fond des ouvertures ou puits d'inspection et dont l'équidistance est un peu moindre que le double de la longueur de la baguette.

Les unions des conduits entr'eux se réalisent au moyen de courbes à raccordement tangentiel, évitant toujours les unions anguleuses, les parties entrantes ou sortantes qui peuvent motiver des obstructions et des depôts de substances putrides.

Dans les villes où les conditions différent de celles plus haut énoncées, l'adoption d'un réseau souterrain d'égouts est conséquemment préférable, car il prête ainsi tous les services incommodes, insalubres ou périlleux possibles, dont il convient de débarrasser les rues et l'habitation de la gent urbaine.

La canalisation, qui doit obéir à un plan général, doit être de plus imperméable, et permettre la sortie rapide de toutes les eaux et bien avant que la décomposition putride ne se soit initiée en elles.

Les matériaux employés en œuvre doivent résister à l'humidité oxigénée et aux charges qu'ils sont appelés à supporter; et ceux employés comme les revêtements, être complètement inattaquables par les eaux qui sur eux courent; ils doivent être bien lissés, et, s'il est possible, polis, afin d'éviter ainsi l'adhérence des matières putrides et augmenter en même temps la vélocité des eaux sales.

Les sections transversals des galeries doivent présenter des formes arrondies; les formes de l'ovale convenant en général aux égouts de petites dimensions qu'un faible volume d'eau parcourt, car alors l'eau acquérant une suffisante hauteur augmente par cela même la vélocité de la nappe liquide; dans les autres cas il est bon de recourir aux formes circulaires et semi-circulaires qui, à périmêtre égal, ont une plus grande aire; d'ailleurs pour que l'homme puisse les parcourir et qu'elles rendent les divers services qu'on attend d'elles, leurs dimensions ne doivent pas être moindres de 1.60 mts. en hauteur et 0.80 mts. en largeur, dimensions qui doivent aller en augmentant dès les dernières ramifications, jusqu'à la zone inférieure où s'accumule un plus grand volume d'eau; les augmentations de sections seront toujours rendues insensibles.

Les unions des branchements avec les galeries et de ces galeries entr'elles, doivent se faire au moyen de courbes tangentielles dont le rayon soit de vingt fois supérieur que la largeur du radier; les pénétrations des différentes parties d'égouts s'obtiennent en prolongean leurs surfaces jusqu'à leur respective rencontre, disposant des arcs sur lesquels reposent les voûtes; quelquefois on construit une seule voûte en la zone d'union, et cette voûte, qui couvre les galeries qui s'unissent prend la forme d'entonoir qui oblige d'établir une cheminée de ventila-

tion en sa partie haute afin d'éviter que l'air infecté s'accumule en elle; cette solution ne saurait être prodiguée car étant très coûteuse, elle est aussi plus difficile à construire que la précèdente.

Les sections des galeries devront être étudiées de manière que chacune de ses parties répondent à de déterminés services; ainsi on calculera la cunette de façon à suffire à l'évasion de toutes les eaux sales; la totalité de la section sera suffisante à l'évacuation des eaux de pluie; sur les arêtes de la cunette, c'est-à-dire au bord de la banquette ou bien sur celle-ci, on empôtrera les rails où courront les vagonnets destinés au transport des résidus solides, et sous la voûte on aménagera les tuyaux et les conduits de distribution d'eaux et des divers fluides.

Pour pouvoir faire le calcul de la section totale des égouts des multiples rues d'une ville, on doit examiner en cette dernière les bassins affluents à chacun des talwegs, en tenant compte que ces talwegs sont déterminés par la topographie du terrain d'asseoiment; par l'urbanisation établie déjà, et par les points ou zones où se practique le déversement des eaux. Le cube d'eaux qui afflue aux égouts est de trois catégories distinctes; de pluie; d'industrie; et les eaux sales, considérant comme telles celles excédents de l'arrosement, lavage et autres usages. Pour fixer le debit correspondant aux eaux de pluie de chaque galerie, il faut connaître l'aire de la région affluente en un point de cette dernière; la hauteur d'eau tombée dans les grandes averses et leur durée, documents qui doivent se déduire de la Météréologie locale de la ville à laquelle on destine le projet; on doit encore tenir en compte que l'eau met à se réunir dans les égouts le double ou le triple du temps qu'elle met à sa tombée, et que, non plus, toute cette pluie arrive au réseau souterrain, car il se perd par évaporation, filtration, imbibition, le tiers ou la moitié de cette pluie, proportion que croît avec la perméabilité des pavages et du terrain. Au volume d'eau de pluie il faut ajouter celui des eaux sales, et de celles qui excèdent, dont la quantité est variable selon la densité des habitants par hectare et selon la dotation par jour et par personne, pouvant considérer aussi que la moitié ou les deux tiers de la dotation qui correspond aux habitants qui s'en servent, arrivent à l'égout, les pertes étant toujours plus petites à mesure que la dotation est grande. En résumé, il faut aussi tenir en compte la dotation relative aux eaux industrielles dont la quantité et régime sont encore plus variables, parcequ'elles dépendent de la situation et nature des établissements industriels de la cité; il est par consequent nécessaire de calculer dans chaque région la proportion relative à cette cause, et, (faite la somme des trois affluences correspondant à l'hectare du terrain et multipliant cette somme par le nombre d'hectares de la région dont le talweg forme la galerie,) on obtient le debit Q, soit le volume auquel il faut donner passage; connaissant de plus la pente du radier J et le rayon moyen R du type de section qui s'adopte et la valeur qui correspond au coefficient a selon l'adhèrence de l'eau par rapport au revêtements qui peut se considérer égal à 52 si le revêtement est bien lissé;

On peut alors faire l'application des formules connues :

$V = a\sqrt{RJ}$; $Q = \omega V$, déduisant de la première la velocité moyenne V, et de la seconde l'aire ω nécessaire au déversement, on recherche parmi les sections adoptées, celle dont l'aire libre ait cette valeur comme minimum.

Quant à la vitesse des eaux sales, il importe que ce soit la plus forte possible et pour ce motif la cunette doit se construire de formes circulaires dans lesquelles R acquiert la valeur maxima et la surface intérièure de celle-ci doit être parfaitement lisse et, s'il est possible, polie avec soin, car alors augmente la valeur de a, et par tant celui de V ; le même résultat s'obtient en augmentant la pente J qui a ses limites determinées par les pentes mêmes de la rue, pentes qui dans les parties basses des villes sont généralement fort réduites. La pente minima admissible pour un réseau, d'égouts depend du volume d'eau affluant à ce réseau, diminuant celui-ci en raison égale des autres circonstances, à mesure que l'autre augmente ; cependant pour ne pas exiger de grands volumes d'eau ou moyens spéciaux de nettoyage, il ne convient pas d'admettre de pentes minimas très petites ; la limite de 0·001 est très acceptable, bien que, parfois, de grandes villes ont été en bessoin d'en admettre de plus petites, pour l'exiger ainsi la topographie du terrain.

Quant à la limite minimum de la vitesse, ou doit tenir en compte, que, dans aucun cas, elle doive jamais descendre de la nécessaire à l'entrainement de toutes les substances putrides apportées par les eaux, pouvant fixer cette limite de vélocité en soixante dix mètres par seconde, au cas de n'admettre aucuns solides trop denses ou volumineux, laquelle au contraire on augmentera si l'on doit donner accès à ces derniers.

Obeissant aux principes exposés plus haut, il se déduit, comme conséquence logique, qu'il convient d'extraire toutes les ordures des maisons et des rues par l'interieur des égouts, bien qu'il faille les doter de moyens ad hoc que permettent de pratiquer avec efficacité ce nouveau service ; si le courant d'eau des égouts etait continue, s'il était suffisant à entraîner les ordures, qui sont moins denses que l'eau, par la flottaison, il est clair qu'on pourrait adopter ce système ; mais il est si difficile de reunir toutes les circonstances, qu'il est préférable, en général, d'extraire les ordures au moyen de vagonnets légèrement perfores dans leur fond.

A cet effet, il faut disposer les rails empotrés sur les arêtes de la cunette, c'est-à-dire à la naissance de la banquette ou sur celle-là, et de façon à ce que la marche des vagonnets soit rendue facile dès les dernières ramifications jusqu'à l'emissaire, et vice-versa ; les ordures se jetteront dans les vagonnets dès les dépôts souterrains qui fonctionneront par un mécanisme très simple et qui ne devront point ressauter sur la voie publique ; ils s'ouvriront automatiquement au moment de jeter les ordures, sans pouvoir, dans aucun cas rester ouverts.

Les dépôts d'ordures auront des formes arrondies et seront exempts d'arêtes et d'angles rentrants ; et dans l'intérieur on construira les bouches d'égout semi-circulaires, qui doivent donner l'entrée aux eaux de pluie et qu'on pourra visiter et nettoyer facilement ; tous ces ouvrages

seront revêtus intérieurement d'un matériel résistant et parfaitement lissé, empêchant ainsi toute adhérence des ordures, et on les nettoyera journellement avec une forte quantité d'eau, mais seulement après en avoir extrait les ordures.

Le transport des résidus solides s'etant opérè par la manœuvre des vagonnets, comme aussi ceux des cunettes des galeries par le moyen des vannes que ce vagonnets portent avec eux, il faudra prendre certaines précautions pour éviter les effets d'une grande agglomération d'eau, et pour la prévenir, on doit disposer d'un réseau téléphonique et de timbres d'avis qui transmettront les ordres au service, et, entr'autres, ceux nécessaires à conduire les vagonnets hors des égouts, ou bien aux parties élevées de ceux-ci, ainsi qu'aux galeries de refuge qui se construiraient.

L'illumination des galeries doit être électrique pour plusieurs raisons, et, entr'autres, celles d'eviter par ce moyen les explosions du gaz d'éclairage, ouvrant le courant électrique là seulement où ce fluide devra prêter les services qui lui incombent. La bonne exploitation du reseau réclame qu'on signale avec clarté les galeries par des écriteaux qui empêchent de les confondre entr'elles, consignant sur ces plaques toutes les indications de longueur, pentes et sections qui peuvent intéresser.

On établira une ventilation si complète qu'en aucune part l'air ne pourra se détenir ou se vicier, et l'on recourra pour cela faire, aux ouvertures des bouches des égouts, aux regards, aux dépôts aménages pour les ordures et surtoût aux tuyaux de descente des eaux de pluie; enfin tous les conduits porteront directement l'air saturé des égouts aux couches atmosphériques supérieures, au-dessus des toitures. Si en un point quelconque, ou pour des circonstances exceptionnelles, les moyens indiqués ne suffisaient pas, on recourra à l'emploi de cheminées d'aspiration ou à d'autres moyens artificiels dont l'emploi doit se restreindre autant que possible.

L'assainissement du sous-sol des villes requiert que les conduits privés de descente des eaux de pluie des latrines, de cuisine, et de lavage qui sont des ramifications de la canalisation publique, réunissent telles conditions, que jamais, ni sous aucun prétexte, se détiennent en eux les matières putrides, et pour obtenir ce résultat, il faut disposer les tuyaux des maisons de façon à ce que l'évacuation de tous les résidus s'opère avec promptitude et rapidement, par des déversoirs expeditifs, et les siphons qui se placent à leur naissance pour incommuniquer la maison et le conduit privé, évitant ainsi à ces maisons les conséquences fâcheuses que les imperfections du reseau pourraient leur causer. Les tuyaux seront droits et faciles à examiner; ils auront le diamêtre strictement nécessaire que réclament les services qu'ils doivent rendre; ils seront exempts de parties rentrantes ou saillantes, seront construits en grès, plomb ou en d'autres matériaux résistants et inattaquables aux eaux sales et aux agents atmosphériques.

Tous les tuyaux de descente devront se prolonger de 2.00 mêtres au-dessus des toits afin que les germes qui ascensionnent par leur secours, atteignent la partie haute de l'atmosphère et s'oxident et minéralisent les matières organisées.

Dans la partie inférieure, les unions des tuyaux de descente avec les égouts seront faites sans recourir à l'intermédiaire d'un siphon quelconque, qui pourra se tolérer seulement dans les cas où les égouts ne réuniraient pas les conditions définitives qui en assure l'immunité.

Pour favoriser l'amélioration de la santé publique dans beaucoup de grandes cités, on ne doit pas compter seulement sur l'évacuation des eaux de pluie, sales et d'industries, car les fluctuations de la couche aqueuse souterraine originent des décompositions putrides sur les matières organiques qui pénètrent dans le sous-sol; pour déjouer es inconvenients que produit cette cause, on recourt au drainage perméable, lequel déverse son contenu en des endroits des égouts appropriés à l'effet; cette canalisation peut-être établie par des tuyaux de terre cuite poreuse, sans le secours d'aucun matériel en ses unions, le tout placé dans la direction et avec la pente rationnelle qui lui correspond.

Les drains peuvent se placer dans le fond même de la tranchée preparée à recevoir le réseau des égouts, et par ce moyen on réalisera avec une grande économie, l'abaissement de la couche d'eau souterraine ainsi que la neutralisation des matières putrides et toxiques qui auraient pénétré dans le sous sol.

C'est dans l'intérieur de la canalisation souterraine et spécialement sous la voûte qu'on place tous les tuyaux des conduits d'eau et des fluides qui doivent être distribués dans la ville, faisant en sorte que le côté destiné au passage des préposés aux divers services, reste entièrement libre, afin d'éviter les contusions et les accidents qui pourraient survenir à ces gens. Quant au mode de pratiquer les prises pour les établissements privés, on simplifie considérablement la chose en se servant d'une galerie ou branchement incommuniquée avec l'égout, la même que celle qui contient les tuyaux de descente des eaux de toutes espèces.

Quand les eaux sales arrivent au point inférieur de la canalisation, il se peut qu'en ce point même commence l'émissaire qui doit conduire ces eaux sales en un lieu désigné pour leur dépuration, ou bien encore qu'il soit nécessaire d'user du moyen d'une élévation; en ce cas des machines font fonctionner des pompes qui portent les eaux à l'endroit qui leur est destiné.

Sur ce sujet nous ne pouvons aussi que faire des indications générales, car plusieurs villes sont entourées de hautes montagnes, sans aucuns champs dans leur voisinage, et alors il faut lancer les eaux à la mer ou recourir aux moyens spéciaux de dépuration, moyens qui ne laissent point d'avoir beaucoup d'inconvénients. Dans les autres cas, on use du système des irrigations agricoles et des filtrations dans le terrain, procédé qui garantit la plus complète depuration des eaux sales au bénefice de la cité d'où elles proviennent, ainsi qu'aux bourgs, hameaux et champs dont les propriétaires obtiennent d'excellents résultats de ces mêmes substances toxiques dont l'état stagnant est si préjudiciable aux êtres humains.

Les résidus urbains, et principalement les matières fécales, constituent le plus riche des engrais, représentant une richesse considérable

qui, perdue une fois, ne peut plus se reprendre; et pouvant produire autant de maux que de bénéfices, étant judicieusement utilisée.

SOMMAIRE.

1. L'assainissement du sous-sol des villes sera d'autant plus complet et perfectionné, qu'on saura faciliter d'avantage et la circulation continue et la transformation de la matière, dans le circuit où celle-ci évolutionne.

2. Les services prêtes par les rues des villes augmentent d'importance à mesure qu'elles s'accroissent et se perfectionnent. Dans les cités de peu de ressources, et dans les zones déprimées on recourt au système tubulaire dont la conservation et nettoyage deviennent faciles au moyen des courants d'eau.

3. Dans les autres cas, on construit un réseau souterrain où sont établis les services incommodes, insalubres ou périlleux, et les galeries servent à l'expulsion des eaux sales, à l'extraction des résidus solides, ainsi qu'à l'installation des canalisations et conduits de toutes espèces.

4. Les sections des galeries seront de forme arrondie et leur aire suffisamment grande pour permettre au personnel de les parcourir librement et d'y prêter leurs services.

4. La pente des réseaux doit diminuer de la partie supérieure à l'inférieure, en raison de l'augmentation du volume d'eau, et des difficultés que présentent les zones basses; les limites de l'inclinaison des pentes oscillent, si cela est possible, entre cinq pour cent et un pour mille; les pentes petites réclament l'emploi d'abondants volumes d'eau pour leur lavage.

6. Les unions des galeries entr'elles devront toujours se faire tangentiellement, et le rayon des courbes être en général vingt fois plus grand que la largeur du radier destiné à évacuer les eaux sales.

7. L'extraction des immondices et des résidus solides urbains pourra se pratiquer dans l'intérieur de la galerie au moyen de vagonnets courant sur des rails empotrés dans les maçonneries. Les trains formés dans l'intérieur des grands collecteurs se dirigeront à l'exterieur pour fertiliser les champs avec ces riches ferments.

8. La ventilation du réseau souterrain devra être grande et complète afin d'éviter l'infection de l'air, sans qu'il y ait jamais aucune partie de galeries, branchements, siphons où manque cette ventilation nécessaire.

9. Le nettoyage des égouts se pratiquera au moyen de la vehiculation aqueuse par courants d'eau continus, s'ils sont abondants, ou bien pas ondées intermittantes qui parcourront une fois ou deux par jour au moins chaque galerie. Pour que la circulation continue s'effectue en bonnes conditions, il faut que la vitesse minimum soit de 0·70 mètres par seconde et que la dotation d'eau ne baisse pas de 200 litres par jour et par personne.

10. Les branchements particuliers s'enlaceront avec le réseau des égouts d'un mode facile et simple au moyen de galeries qui permettront d'inspectionner les branchements et d'y placer les ramifications et tuyaux de prise, s'unissant aux canalisations et conduits de toutes espèces.

11. L'excessive humidité du sous-sol s'évitera dans les villes qu'aient cet inconvénient au moyen du drainage perméable disposé sur les côtés du réseau des égouts.

12. La dépuration agricole complète l'assainissement du sous-sol des villes, constituant, quand on peut l'appliquer opportunément, le moyen le plus higiènique et économique de tous les systèmes connus.

DISCUSSION.

The President said they must now close their proceedings for the day and for the Session. He should like to express the thanks of the committee to those gentlemen who had come so far and rendered such valuable services in the presenting and discussing of the several papers. He should be sorry for them to dissolve without according to their invaluable secretary, Mr. Middleton, their best thanks for the services he had rendered. There was no member of the Organising Committee or of the Council, or of the Sectional Committee, there was no gentleman in the room or out of it who was so able to judge as he was, owing to the peculiar circumstances in which he had been placed as President of the Section, or who could form an adequate conception of the value of Mr. Middleton's services from the very commencement of the work, several months ago, until the present time. He hoped they would give him a vote of thanks by acclamation for the services he had rendered.

A vote of thanks to Mr. Middleton for his services as secretary was then carried by acclamation.

Mr. Middleton said he was exceedingly obliged to them for the manner in which they had received the remarks of Sir John Coode. He could say that, although the duties of the secretaryship of that section had been heavy, they had been a labour of love. He only hoped that his work had been properly done, and that they were satisfied with it; if so, he was well repaid.

The President said the next stage would be that in course of time members would receive the report of their proceedings in print. He thought he was justified in saying that the result of that gathering in London had not been surpassed in value by those of any other meetings of the Congress in any other city in Europe.

Mr. Middleton said that in the absence of the vice-presidents he hoped he might be allowed to propose a hearty vote of thanks to Sir John Coode, who had given up an immense amount of his valuable time to presiding at the meetings, much more even than could have been expected from him. They were very much obliged to him for the trouble he had taken in attending not only these meetings, but the meetings of the committee. The organisation of the scheme could not have gone on in the way it had, if Sir John Coode had not given so large an amount of attention to it.

A vote of thanks was then passed to the President by acclamation.

The President said he had endeavoured to do that, as every other matter which he took in hand, to the best of his power, not putting his hand to the plough and looking back. He thanked them for the recognition they had tendered to him for so doing.

INDEX.

A.

Page

Abkühlung des Wassers durch Anlage von Kühlschächten (Professor A. Oelwein) - - 175
Alliott (Mr.), remarks in discussion on The refuse destructor - - 221
Altona, Die typhus-epidemie in, 1891, und das filtrirte Flusswasser (W. Kümmel) - - - 229
Anderson (J. T. Noble), remarks in discussion on The sanitation of a mining settlement - - 36
Anderson (Mr.), remarks in discussion on Abkühlung des Wassers durch Anlage von Kühlschächten - - 184
Anderson (William). The revolving purifier for treatment of potable waters by means of metallic iron - 129
Aperçus sur l'assainissement du sous-sol des villes. (Don Pedro Garcia Faria) - - 252
Application of an intercepting reservoir, of the type of Mouras's Fosse, and of a peat filter for sewage to the separate system of sewerage. (L. Pagliani) - - 74
Assainissement des villes en Italie, L' (Prof. Pacchiotti) 17
Assainissement des Villes : Traitement des eaux d'égout par les procédés agricoles. (Aimé Bonna) - - - - - 65
Assainissement du sous-sol des villes. (Don Pedro Garcia Faria) - - - 252
Atmosphere as a diluter and diffuser, the - - - 53

B.

Balfour (D.), remarks in discussion on sewage disposal - - 43
Bâtiments et moyens de transport des Chemins de fer - - - 120
Bechmann (M.). De la distribution dans les villes de deux eaux de qualité différente par des canalisations distinctes - - - 102
Bechmann, Mr., remarks in discussion on French and English systems of sewerage - - 35
—— ——, remarks in reply - 117
"Beehive" refuse destructor, description of - - - 195
Bengal Presidency, supply of river-water in the - - - 245
—— ——, supply of tank or pond water in the - - - - 245
—— ——, the supply of well water in the - - - - - 244
Berlin, die kanalisation der Stadt (Stadtrath Marggraff) - - 91
Berrington (R. E. W.). The Wolverhampton sewerage works 89
Binnie (Alex. R.). Water supply 100
—— ——, remarks in discussion on Municipal engineering - - 227
—— ——, remarks in discussion on separate water-supply for domestic purposes, &c. - - 118
Bonna (Aimé). Assainissement des Villes : Traitement des eaux d'égout par les procédés agricoles - - - - - 66
Boulnois (H. Percy). Municipal engineering - - - - 223
—— ——, remarks in reply - 228
Bruce (Dr. William). How best to dispose of the refuse of large towns - - - - 218
Buchan (Mr.), remarks in discussion on Sanitation in India - - 18
Buildings, the removal of sewage after leaving. (Reginald E. Middleton) - - - - 27

C.

Camberwell refuse, treatment of - 190
Canalisation, double, advantages de - - - - - 104
—— ——, système de - - 103
Caroe (W. D.). The better ventilation of town sewers - - 52
Cesspits, the system of sealed, for sewage - - - - - 28
Chemins de fer et des voyageurs, L'Hygiene des (Louis de Csatáry) - - - 119

Page

Fume cremator, figure showing plan of twelve-cell destructor and - - - - 197
—— ——, Jones's patent, figure showing - - - 200

G.

German Towns, On the cleansing of the streets and the removal of household refuse in. (Th. Weyl) 203
Grantham (Richard F.). Drainage and irrigation of land in their relations to health - - 149
—— ——, remarks in reply - 159
Ground-water, influence of, as a cause of disease - - 145
—— ——, parallelism between the deaths of children under five years of age and the lowness of the - - - - 147
—— ——, co-existing sanitary conditions influence the results of the movements of - - 147
—— ——, table giving the level of the lowest, and the death-rate of children under five years of age at Croydon - - - - 148
—— ——, upon health, The influence of. (Baldwin Latham) 145

H.

Hall (Joseph), remarks in discussion on Refuse burning - - 221
Hampstead, refuse treatment of - 190
Harrison (J. Thornhill), remarks in discussion on Municipal engineering - - - - 228
Harpur (William), remarks in discussion on Drainage and irrigation of land in their relations to health - - - - 157
Henrot (Henri). Les procédés d'assainissement des villes - 84
Hime (Dr. T. W.), remarks in discussion on ventilation of town sewers - - - - 58
Holman (Stephen), remarks in discussion on The better ventilation of town sewers - - 59
How best to dispose of the refuse of large towns. (Dr. William Bruce) - - - 218
Hygiène des Chemins de fer et des voyageurs. (Louis de Csatáry)- 119

I.

Page

Indian cities, density of population in - - - - - 18
India, Sanitation in. (Baldwin Latham) - - - 18
India, The water supply of. (R. Pringle) - - - 242
Influence of ground-water upon health, The. (Baldwin Latham) 145
Italie, L'assainissement des villes en. (Prof. Pacchiotti) - - 17

J.

Jones (Col. Alfred), remarks in discussion on The removal of sewage after leaving buildings - 32
Jones (Charles). The refuse destructor - - - 188
—— ——, remarks in reply - 222

K.

Kanalisation der Stadt Berlin. (Stadtrath Marggraff) - - 91
Keeling's patent sewer gas destructor - - - - 50
Kensington refuse, treatment of - 189
Kühlschaechten, Abkühlung des Wassers durch Anlage von. (Prof. A. Oelwein) - - 175
Kümmel (W.). Die typhus-epidemie in Altona, 1891, und das filtrite Flusswasser - - 229
—— ——, remarks in discussion on Drainage and irrigation of land in their relations to health - 159
—— ——, remarks in discussion on Separate water supply for domestic purposes, &c. - - 116
—— ——, remarks in discussion on Abkühlung des Wassers durch Anlage von Kühlschaechten - 183
—— ——, remarks in reply - - 252

L.

Land, Drainage and irrigation of, in their relations to health. (Richard F. Grantham) - 149
Latham (Baldwin). The influence of ground-water upon health - 145
—— ——, Sanitation in India - 18

O.

Page

Odling (Dr. Wm.), remarks in discussion on separate water supply for domestic purposes, &c. - 117
Oelwein (Professor A.), Abkühlung des Wassers durch Anlage von Kühlschaechten - - 1k5
Oesten (G.). Eindringen von Unreinigkeiten in Druckwasserleitungen - - - - 167

P.

Pacchiotti (Prof.). L'Assainissement des villes en Italie - 17
—— ——, remarks on the sewerage system of Rome - - 44
—— ——, remarks in discussion on the French and English systems of sewerage - - 34
Pagliani (L.). On the application of an intercepting reservoir, of the type of Mouras's Fosse, and of a peat filter for sewage to the separate system of sewerage - 74
Peat filter for sewage, &c. (L. Pagliani) - - - 74
"Perfectus" destructor, description of - - - 195
—— ——, where adopted - 195
Pipe ventilators, advantage of - 54
Presidential address. (Sir John Coode) - - - 7
Pringle (R.). The water-supply of India - - - - 242
Procédés d'Assainissement des Villes. (Henri Henrot) - 84
Projets pour l'alimentation en Eau potable d'une grand partie de la France au moyen de l'eau des lacs de Neuchâtel et du Léman. (Guillaume Ritter) - - 160

R.

Read (R.). Sewer and drain ventilation - - - 47
—— ——, remarks in discussion on The better ventilation of town sewers - - - 64
—— ——, remarks in discussion on The removal of sewage after leaving buildings - - 36

Page

Refuse burning. (W. Geo. Laws) - 210
—— ——, table giving result of five years, in Newcastle-on-Tyne 217
Refuse composed of crude manure, sound material, and unsound stuff - - - - 211
—— destructor, The. (Charles Jones) - - - 188
——, difference between that of English and continental towns - 205
——, experiments in the burning of house. (J. F. Meyer) - 205
——, experiments made at Copenhagen in the burning of - 206
——, household, On the cleansing of the streets and the removal of, in German towns. (Th. Weyl) 203
—— of large towns, How best to dispose of the. (Dr. William Bruce) - - - - 218
——, household, results of burning the, in summer - - 209
——, household, results of burning the, in winter - - 206
——, treatment of, at Camberwell 190
——, treatment of, at Hampstead - 190
——, treatment of, at Kensington 189
Removal of sewage after leaving buildings. (Reginald E. Middleton) - - - - 27
Revolving purifier for treatment of potable waters by means of metallic iron. (Dr. William Anderson) - - - 129
Ritter (Guillaume). Projets pour l'alimentation en eau potable d'une grande partie de la France au moyen de l'eau des Lacs de Neuchâtel et du Léman - 160
River pollution and water supply, Sewage disposal with reference to. (Prof. Henry Robinson) - - 11
Rivers free from pollution, importance of keeping, in new countries 13
Rivers Pollution Prevention Act of 1876, desirable amendment to - 12
——, tables of analysis of contents of - - - 172–3
River water in the Bengal Presidency, supply of - - 245
Robinson (Professor Henry). Sewage disposal with reference to river pollution and water supply 11
—— ——, remarks in discussion on The better ventilation of town sewers - - - 63

Page

Robinson (Professor Henry). Remarks in discussion on Separate water supplies for domestic and for sanitary purposes at Southampton - - - 111
—— ——, remarks in discussion on the Abkuhling des Wassers durch Anlage von Kuhlschaechten - - - 180
Roechling (H. A.). Remarks in discussion on Municipal engineering - - - 227
—— ——, remarks in discussion on The better ventilation of town sewers - - - 61
—— ——, remarks in discussion on Sewage disposal with reference to river pollution and water supply - - - 38

S.

Sand filtration as an effectual preventive of disease, little value of 102
Sanitation in India (Baldwin Latham) - - - 18
Sanitation of a mining settlement. (A. Mault) - - - 31
Self-purification of rivers, The present state of our knowledge concerning the. (Percy C. Frankland) - - 169
Separate water supplies for domestic and for sanitary purposes at Southampton. (Wm. Matthews) 108
Service de santé des chemins de fer - - - - 124
Sewage disposal with reference to river pollution and water supply. (Henry Robinson) - - 11
—— filtration, important function of micro-organisms in - 15
—— matter to storm-water, proportion of, in England - 28
——, result of application of, to land generally and to non-porous soils - - - - 14
——, the chief characteristics of fresh - - - - 13
—— disposal, the earth system of - 28
——, The removal of, after leaving buildings (Reginald E. Middleton) - - - - 27
Sewer and drain ventilation. (H. Read) - - - 47
—— gas, Keeling's patent destructor - - - 50
—— ventilation. (W. Santo Crimp) 45
Sewerage, advantages of the separate system of - - - 29
——, On the application of an intercepting reservoir, of the type of Mouras's Fosse, and of a peat filter for sewage to the separate system of. (L. Pagliani) - 74
——, choix des terrains d'epuration - - - - 85
——, distribution de la canalisation intérieure et des collecteurs - 86
——, établissement de canaux évacuateurs et suppression de chutes d'eau - - - 87
——, établissement de cheminées d'appel avec bruloir - - 88
——, établissement de reservoirs de chasse - - - 88
——, étude de la nature du sol - 84
——, French and English systems of. (James Lemon) - - 24
—— of towns, importance of appropriately dealing with - 11
——, l'épuration par le sol - 84
——, separate system of, most appropriate for certain places in India - - - - 19
——, the system of sealed cesspits 28
——, the pail system of - - 28
——, tout à l'égout system of, 26
—— works, The Wolverhampton. (R. E. W. Berrington) - 89
Sewers, argument against the ventilation of - - 29
——, The better ventilation of town. (W. D. Caroe) - - 52
Sijmons (Mr.), remarks on the sewerage of Amsterdam - - 37
Simpson (Dr.), remarks in discusion on The water supply of India - - - - 250
Small-pox, high death-rate from, in India - - - 23
Smith (Dr. Solomon) remarks in Abkühlung des Wassers durch Anlage von Kühlschaechten - 184
Southampton, the separate water supplies for domestic and for sanitary purposes at. (Wm. Matthews) - - - 108
Storm-water, proportion of to sewage matter in England - 28
Streets, On the cleansing of, and the removal of household refuse in German towns. (Th. Weyl) 203
Surveyor, development of, into municipal engineer - - 226

T.

Page

Tank or pond water in the Bengal Presidency, supply of - - 245
Thomson (Gilbert), remarks in discussion on The removal of sewage after leaving buildings - 36
—— (James), remarks in discussion on The removal of sewage after leaving buildings - 37
Thornton (T. H.), remarks in discussion on Drainage and irrigation of land in their relations to health - - - 156
"Tout à l'égout" system of sewerage - - - 26
—— —— at Marseilles - - 73
Towns, essential difference in the conditions of maritime and inland - - - 141
Typhoid fever communicated by spring-water flowing miles underground from a neighbouring valley at Lausen in Switzerland - - - 101
Typhus-epidemie in Altona, 1891, und das filtrirte Flusswasser, Die. (W. Kümmel) - - 229

V.

Van Overbeck de Meyer (Prof. D.), remarks in discussion on The better ventilation of town sewers 62
—— ——, remarks on The removal of sewage after leaving buildings 44
Ventilation of town sewers, The better. (W. D. Caroe) - 52
——, Sewer. (W. Santo Crimp) - 45
——, Sewer and Drain. (R. Read) 47
Village well in India, description of - - - 244
Villes en Italie, L'assainissement des. (Prof. Pacchiotti) - 17
Voiture d'ambulance des chemins de fer R. de l'État hongrois, description de la - - 127
Von Pettenkofer (Professor). Investigations with reference to the sewage pollution of the river Isar, made by - - - 13

W.

Page

Wales (Philip S.). The purification of water by rapid filtration - 133
Water, average quantity of, delivered in 1890 to the inhabitants of London - - - 9
——, importance of guarding drinking, from contamination - 101
Water supplies, generally extremely defective in India - - 20
—— supply. (Alex. R. Binnie) - 100
—— ——, measure for improving, in India - - - 247
—— —— of India, The. (R. Pringle) - - 242
—— —— of maritime towns. (Edward F. Willoughby) - 140
—— ——, Sewage disposal with reference to river pollution and. (Henry Robinson) - - 11
—— supplies, The separate, for domestic and for sanitary purposes at Southampton. (Wm. Matthews) - - - 108
Waters, potable, Revolving purifier for treatment of, by means of metallic iron. (William Anderson) - - - 129
Well water in the Bengal Presidency, supply of - - - 244
Weyl (Th.). On the cleansing of the streets and removal of household refuse in German towns - 203
Whiley (Henry). Remarks in discussion on The refuse destructor 219
Whitaker (W.). On maps showing the area of chalk available for water supply in the central and eastern parts of the London basin - - - 144
Willoughby (Edward F.). The water supply of maritime towns - 140
Wirkung der electricitaet auf die suspendirten und gelösten Stoffe der Abwässer, ueber die. (Claudio Fermi) - - 138
Wolverhampton, population of - 89
—— sewerage works. (R. E. W. Berrington) - - - 89

LONDON: Printed by EYRE and SPOTTISWOODE,
Printers to the Queen's most Excellent Majesty,

VE
JL